



Mountains: Our Life, Our Future

Progress and perspectives on
sustainable mountain development

From Rio 1992 to Rio 2012 and beyond

A global synthesis based on 10 regional reports
Clara Ariza, Daniel Maselli and Thomas Kohler

This publication may be reproduced in whole or in part in any form for educational or non-profit purposes without special permission from the copyright holders, provided acknowledgement of the source is made. The lead organizations would appreciate receiving a copy of any material that uses this publication as a source.

No use of this publication may be made for resale or for any commercial purpose whatsoever without prior permission in written form from the copyright holders. The use of information from this publication concerning proprietary products for advertising is not permitted.

Disclaimers

The views expressed in this document are those of the authors and do not necessarily reflect the views of the involved partner organizations and governments.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. We regret any errors or omissions that may have been unwittingly made.

© 2013

Published by the Centre for Development and Environment (CDE) of the University of Bern, with the support of the Swiss Agency for Development and Cooperation (SDC) and an international team of contributors

Authors: Clara Ariza (FDDM), Daniel Maselli (SDC), Thomas Kohler (CDE)

Design and layout: Simone Kummer (CDE)

Language editing: Marlène Thibault, Anu Lannen (CDE)

Citation

Ariza C., Maselli D. and Kohler T. 2013. *Mountains: Our Life, Our Future. Progress and Perspectives on Sustainable Mountain Development from Rio 1992 to Rio 2012 and Beyond*. Bern, Switzerland: Swiss Agency for Development and Cooperation (SDC), Centre for Development and Environment (CDE). 90 pp.

This publication is available from:

Centre for Development and Environment (CDE)
University of Bern
CH-3012 Bern, Switzerland
www.cde.unibe.ch

Swiss Agency for Development and Cooperation (SDC)
CH-3003 Bern, Switzerland
www.deza.admin.ch

Cover photo: Atacama Desert, Chile. Olivier Chassot

ISBN: 978-3-905835-18-2

Mountains: Our Life, Our Future

Progress and perspectives on sustainable mountain development

From Rio 1992 to Rio 2012 and beyond

A global synthesis based on 10 regional reports

Clara Ariza, Daniel Maselli and Thomas Kohler

Contents

Foreword	5
Acknowledgements	7
1 Global overview of sustainable mountain development	9
Sustainable development depends on mountain ecosystems and resources	10
Key global trends of the past 20 years affecting sustainable mountain development	
Key regional trends of the past 20 years affecting sustainable mountain development	
Shortcomings of sustainable mountain development over the past 20 years	
2 Mountains matter for <i>The Future We Want</i>	19
Places of hope and concern	20
Mountains play a key global role	
Mountains are the water towers of the world	
Mountains are hotspots of global biodiversity	
Mountains are a home, a source of income and a place of diverse cultural heritage	
Mountains in <i>The Future We Want</i>	
3 Road map for sustainable mountain development: shaping the new Global Mountain Agenda	27
Policy principles and policy actions	28
Policy principles	
Policy actions	
4 Regional issues and opportunities for sustainable mountain development	33
Issues and opportunities in the Andes	34
Why mountains in the Andean region matter	
How current trends affect sustainable mountain development in the Andes	
Policy action for the Andes	
Issues and opportunities in Meso-America	39
Why mountains in Meso-America matter	
How current trends affect sustainable mountain development in Meso-America	
Policy action for Meso-America's mountain	

Issues and opportunities in North America	43
Why mountains in North America matter	
How current trends affect sustainable mountain development in North America	
Policy action for North America's mountains	
Issues and opportunities in Africa	50
Why mountains in Africa matter	
How current trends affect sustainable mountain development in Africa	
Policy action for Africa's mountains	
Issues and opportunities in the Middle East and North Africa	54
Why mountains in the Middle East and North Africa matter	
How current trends affect sustainable mountain development in the Middle East and North Africa	
Policy action for the mountains of the Middle East and North Africa	
Issues and opportunities in the Hindu Kush Himalayas	60
Why mountains in the Hindu Kush Himalayan region matter	
How current trends affect sustainable mountain development in the Hindu Kush Himalayas	
Policy action for the Hindu Kush Himalayas	
Issues and opportunities in Central Asia	66
Why mountains in Central Asia matter	
How current trends affect sustainable mountain development in Central Asia	
Policy action for Central Asia's mountains	
Issues and opportunities in Southeast Asia and the Pacific	72
Why mountains in Southeast Asia and the Pacific matter	
How current trends affect sustainable mountain development in Southeast Asia and the Pacific	
Policy action for the mountains of Southeast Asia and the Pacific	
Issues and opportunities in central, eastern and southeastern Europe	76
Why mountains in central, eastern and southeastern Europe matter	
How current trends affect sustainable mountain development in central, eastern and southeastern Europe	
Policy action for the mountains of central, eastern and southeastern Europe	
Issues and opportunities in the European Alps	80
Why the European Alps matter	
How current trends affect sustainable mountain development in the European Alps	
Policy action for the European Alps	
Further reading	87

Foreword



In 1992, mountains unexpectedly received a significant amount of political attention at the United Nations Conference on Environment and Development (UNCED), also known as “Rio 1992” or “the Rio Earth Summit”. Viewed as fragile ecosystems that matter to all humankind, mountains were granted a chapter in the *Agenda 21* United Nations action plan that emerged from the conference. Since then, a wide range of efforts by different actors have been undertaken to promote sustainable mountain development (SMD). Some of these efforts

were a direct result of the original Rio conference, while others grew out of subsequent international resolutions and treaties, such as the Kyoto Protocol, the Hyogo Framework for Action and the International Treaty on Plant Genetic Resources for Food and Agriculture. Still others were initiated independently at national and local levels.

Twenty years later, this global commitment to mountains and the need for sustainable mountain development were re-emphasized in the final document of the 2012 United Nations Conference on Sustainable Development. The Rio+20 conference document, *The Future We Want*, contains three paragraphs devoted to summarizing the global benefits of mountain regions and the critical role mountains play in sustaining life on Earth. However, the paragraphs also highlight mountain ecosystems’ vulnerability to the adverse effects of environmental change, land conversion and degradation, natural disasters and various stressors. The possible negative impacts of retreating mountain glaciers – for human well-being and the environment – are particularly emphasized. Further, the paragraphs acknowledge the hardships often faced by inhabitants of mountain regions. Frequently members of indigenous populations, many of these mountain dwellers are poor, marginalized and disadvantaged. But, as the text passages point out, these same mountain dwellers are the true stewards of healthy mountain environments and well-functioning ecosystems.

In order to support a renewed “Global Mountain Agenda” and to follow up the Rio+20 conference with concrete actions, it is important to assess and understand what has changed. Concerns about climate change have grown over the last decade, including its direct effects on mountain ecosystems and people. The accelerating pace of unexpected and unpredictable political, social, economic and technological change also poses threats to mountain development in different geographic contexts.

One of the biggest global supporters of sustainable mountain development of the past 20 years, the Swiss Agency for Development and Cooperation (SDC) has commissioned a series of reports assessing progress and perspectives in selected mountain regions, including key regions in Central Asia, the Hindu Kush Himalayas, Southeast Asia and the Pacific, the Middle East and North Africa, the European Alps, South America and Meso-America. In addition, the Swiss Federal Office for Spatial Development (ARE) commissioned a report on the European Alps, and the United Nations Environment Programme (UNEP) commissioned reports on mountain areas in Africa as well as in central, eastern and southeastern Europe. Thanks to an independent effort by committed partners in sustainable mountain development, a report on North American mountain areas was also prepared recently.

Finally, the Centre for Development and Environment (CDE) has compiled a global report examining institutional framework conditions at various levels and the scope for a "green economy" in the context of sustainable mountain development.

Thanks to the active involvement of key local, regional and global actors, the insights contained in these reports may be used to promote a renewed Global Mountain Agenda and to shape new initiatives, including formulation and implementation of Sustainable Development Goals (SDGs) to replace or complement the current Millennium Development Goals (MDGs). This could enable definition of a subset of Sustainable Mountain Development Goals (SMDGs), providing clear and measurable targets for the next 10 or 20 years. Significantly advancing sustainable mountain development will require the involvement of greater numbers of actors from diverse backgrounds – this should include novel partnerships and joint ventures between the public sector, the private sector and broader civil society.

A handwritten signature in blue ink, appearing to read 'M. Dahinden', with a long horizontal stroke extending to the right.

Martin Dahinden
Director General
Swiss Agency for Development and Cooperation

Acknowledgements

The present report draws on a wide range of recent sources and in particular attempts to compile in a simple and concise manner the information presented in regional and global reports and policy briefs prepared by multiple partners for the Lucerne World Mountain Conference in 2011 and the United Nations Rio+20 conference in 2012. The authors would like to thank the lead organizations that coordinated these reports, as well as the teams of authors who wrote them. The lead organizations include the following institutions, listed alphabetically by region:

Africa: United Nations Environment Programme (UNEP); AfroMont

Andes: Consorcio para el Desarrollo Sostenible de la Ecorregión Andina (CONDESAN)

Central Asia: University of Central Asia (UCA); Zoï Environment Network; GRID-Arendal

Central, eastern and southeastern Europe: UNEP; Interim Secretariat of the Carpathian Convention; European Academy (EURAC Research)

European Alps: Swiss Federal Office for Spatial Development (ARE); Centre for Mountain Studies (CMS), Perth College, University of the Highlands and Islands (UHI); University of Geneva

Hindu Kush Himalayas: International Centre for Integrated Mountain Development (ICIMOD)

Meso-America: Latin American School for Protected Areas (ELAP); University for International Cooperation (UCI); Tropical Science Center (TSC)

Middle East and North Africa: Sultan Qaboos University (SQU)

North America: Aspen International Mountain Foundation (AIMF); Telluride Institute

Southeast Asia and Pacific: ICIMOD; Mountain Partnership focal point Southeast Asia


Global: Swiss Agency for Development and Cooperation (SDC); Centre for Development and Environment (CDE), University of Bern.

The authors would also like to thank all the individuals who generously provided their time and efforts to draft the initial concept and to review, edit and improve earlier versions of the present report. Among them are (in alphabetic order):

Olivier Chassot, of TSC; Christian Devenish, of CONDESAN; Karinjo DeVore, of AIMF; Greg Greenwood, of the Mountain Research Initiative (MRI); Madhav Karki, of ICIMOD; Tek Jung Mahat, of ICIMOD; Roger Muchuba, of the Civil Society Working Group on Climate and REDD of the Democratic Republic of Congo; Viktor Novikov, of Zoï Environment Network; Martin Price, of CMS; Benedicto Sanchez, Mountain Partnership focal point Southeast Asia; Otto Simonett, of Zoï Environment Network; Andrew Taber, of The Mountain Institute (TMI); Reginald Victor, of SQU; and Rebecca Wallace, of AIMF.

Finally our thanks go to all contributors of photos, maps and other illustrations.





Global overview of sustainable mountain development



Sustainable development depends on mountain ecosystems and resources

Mountains cover approximately one-quarter of the Earth's land surface, are home to about 12 percent of the global population and provide indispensable goods and services to all humankind.

Meteora Monastery near Pindus Mountains, view of the Plain of Thessaly, Greece. (Jürg Krauer)

Mountain regions supply half of the world's population with freshwater, are repositories of important cultural and biological diversity, are sources of key raw materials and are important tourist destinations.

Yet many of these regions are sites of dire poverty, widespread land degradation and inequitable land rights. For example, estimates indicate that approximately 40 percent of mountain populations in developing and transition countries – about 270 million people – are vulnerable to food insecurity, and half of these 270 million suffer from chronic hunger. Further, mountain ecosystems and people have already begun to experience the negative effects of climate change.

Mountain ecosystems' vital role in the lives of upstream and downstream populations, whether rural or urban, is now recognized at the international policy level. Extending far beyond national borders in many areas, mountain systems have become the object of international treaties and transboundary collaboration initiatives; examples include the Andean Community, the Alpine Convention and the Carpathian Convention. Nevertheless, despite mountains' strategic importance, many mainstream national and international development efforts have neglected mountains, which are often perceived as remote, inaccessible areas that are "hard to reach". A combination of government neglect, insufficient private investment and environmental fragility has worsened the socio-economic situation of many mountain people.

Overall, mountain regions – especially in developing and transition countries – have not performed according to their real potential since 1992. Instead of playing a vibrant role in the development of their respective nations, mountain areas have – with some notable exceptions – largely failed to keep pace with the progress in surrounding lowland areas, especially in terms of environmental protection, social improvements and economic growth. Mountain areas have also generally failed to garner adequate recognition for the benefits they provide locally, nationally and regionally.



Figure 1.1: Mountains are our water sources and reservoirs. (Illustration by E. Mantilla-Meluk, Bogotá, Colombia)

All too often, mountain regions suffer losses of critical environmental capital due to mining, deforestation, soil erosion, desertification, decreasing or lost biodiversity, and pollution. Social capital has been lost due to outmigration, the breakdown of family structures and social networks, sociocultural disintegration and other processes. Few economic improvements have been achieved in mountain areas; instead, many mountain communities are experiencing more poverty and suffering from persistent violent conflicts, the absence or destruction of infrastructure and lack of investment. The reasons for these disappointing developments are highly diverse and vary according to the respective historical, geopolitical, environmental and sociocultural context of each mountain area. This complexity must be considered when searching for new pathways to achieve or promote sustainable mountain development.

In many mountain regions, outmigration has meant that there is less human power available for labour-intensive, traditional land-use systems. Physically fit young people often leave mountain areas to find paid work elsewhere. While the resulting remittances may improve mountain dwellers' incomes and possibly their livelihood conditions, outmigration has other negative effects, such as increased burdens on women (e.g. "feminization of mountain agriculture") or abandonment of labour-intensive land-use practices that preserve mountain ecosystems (e.g. by protecting against erosion and landslides). While such outmigration typically involves young men, or entire families, in Southeast Asia and the Pacific, in particular, more and more women are leaving mountain communities. Young women in this region are encouraged to migrate in search of work and to send back remittances. This process is seriously affecting the region's social and cultural fabric, as more and more communities must cope with the absence of mothers.

Indeed, while outmigration may increase communities' economic capital, it often harms communities' social capital through family separations, changes and losses in value systems and knowledge systems, etc. Nevertheless, outmigration's



Figure 1.2: Mountains are home of glaciers and people. (Illustration by E. Mantilla-Meluk, Bogotá, Colombia)

scale and impact differs geographically. This is especially true in Africa and South America, where mountain areas are often considered better places to live than lowland areas. As a result, population density has increased in these mountain areas, increasing pressures on scarce resources such as arable land.

Compounding this trend of increasing population density in certain mountain areas, globalization and broader human population growth have significantly increased pressure on mountain resources, especially water and minerals. This has triggered large-scale environmental degradation, decreasing the locally available natural capital that is so critical for sustainable mountain development. Adding to this, many mountain areas are the site of violent conflicts – often triggered by geopolitical interests that have otherwise hindered sustainable mountain development, such as in the Caucasus or the Hindu Kush Himalayan region. The consequences of the Soviet Union's demise, for example, are still felt in the mountains of Central Asia, the Caucasus and parts of eastern Europe, where development has failed to recover and mountain communities continue to face extreme hardship.

But not all is doom and gloom with regard to sustainable mountain development. On the contrary, a wealth of initiatives, programmes and projects have emerged since Rio 1992, providing opportunities to support mountain communities and enhance cooperation. Various community-based organizations and networks have been founded in mountain areas. Examples include the Alliance of Central Asian Mountain Communities (AGOCA) and the Alliance of the Alps, which have enabled villages in Kyrgyzstan, Tajikistan and Kazakhstan and seven Alpine countries, respectively, to exchange experiences and collaborate.

Clear progress has also been made in designating protected mountain areas for the conservation of biodiversity. Further, a common vision of enhanced transnational cooperation has been established – for example regarding implementation of ecological corridors, national parks and extended protected areas – that



Figure 1.3: Mountains are our future heritage.
(Illustration by E. Mantilla-Meluk, Bogotá,
Colombia)

is supported in several mountain regions (including Meso-America, the European Alps, Southeast Asia and the Carpathians); this could provide a solid basis for expanded international cooperation on sustainable mountain development.

Key global trends of the past 20 years affecting sustainable mountain development

Over the past 20 years, the following key global trends have affected sustainable mountain development in many regions:

- A growing climate change discourse and climate change's tangible effects have increased political interest in mountain areas, particularly regarding rapid glacier melting, increased risks of natural disasters and possible near-term water-supply shortages, especially in major urban centres in both lowlands and mountains.
- Many non-armed and armed conflicts have taken place in mountain regions, dramatically hindering their development.
- Globalization has triggered a range of secondary processes, such as rapid urbanization and increasing outmigration, which have significantly affected mountain regions in both positive and negative ways.
- Continuous global population growth and economic growth have increased pressures on mountain resources and exacerbated large-scale environmental degradation. These outside pressures and environmental degradation are disrupting the sustainable development of many mountain areas and the livelihoods of millions of rural and urban people, especially in poor countries.

Key regional trends of the past 20 years affecting sustainable mountain development

Andes

- Continued urbanization and increasing population density in mountains are intensifying pressure on natural resources.
- Mining proliferation has led to environmental degradation that increasingly affects local communities who lack bargaining power and receive few benefits from the industrial exploitation of their subsoil resources.
- Recognition of the importance of local traditional knowledge and mountain agrobiodiversity has increased, as has awareness of the greater economic benefits to be had via cost and benefit sharing and intellectual property rights.
- Climate change, glacier retreat and mountain ecosystem degradation are threatening the supply and quality of mountain water for use in agriculture and in major urban centres, including capital cities such as Quito and Lima.

Meso-America

- The greatest overall threat to mountains in this region is climate change. Other direct threats stem from the mining industry, hydropower dams, urban encroachment, deforestation and soil erosion.
- Mountains provide the region's biggest opportunity to strengthen conservation and sustainable development initiatives, in contrast to the more densely populated and industrially developed lowlands.

North America

- Mountain populations are growing, mainly because of "amenity migration" and tourism; these have brought investment in infrastructure and services, but also negative impacts on biodiversity.
- Climate change represents a major threat to natural mountain ecosystems and to national water security. Major cities, such as Los Angeles, Phoenix and Las Vegas, have acquired all possible water use rights in the Colorado River system to help protect against water shortages.
- Mountaintop removal and hydraulic fracturing ("fracking") mining practices are destroying important mountain ecosystems as well as the goods and services they provide, with little benefit to local communities.
- Both public and private efforts have helped protect mountain areas through careful land stewardship, for example by establishing extensive federal parks, wilderness areas and numerous mountain research centres including environmental programmes devoted to sustainable mountain development.

Africa

- Failure to mobilize resources for investment in sustainable mountain development remains a major bottleneck in the region. Many mountain communities struggle with pervasive poverty, which also hampers broader efforts to secure key ecosystem services provided by mountains.
- Mountain-relevant data remain scattered, unprocessed and unpublished, complicating their use in policy and resource-management initiatives and practices. As a result, relevant decisions are typically made based on poor or lacking information.
- Many mountain communities remain isolated and are unable to attract investment for development; occasional exceptions include cases of outside investment on behalf of mountain tourism. Hence, these mountain areas continue to lag behind average global development.

- Outmigration and related remittances are soaring, with both positive and negative impacts on mountains and mountain communities.
- Exploitation of natural resources (e.g. gold, mercury, uranium) by foreign companies has increased environmental hazards as well as local resistance to mining. Mining benefit-sharing arrangements that would aid local populations are the subject of debate.
- Tensions and disputes have arisen over regional water resources – mainly originating in Tajikistan and Kyrgyzstan – that are required for extensive agriculture (food and cotton) and hydropower throughout the region. This impacts efforts towards sustainable mountain development at both national and regional levels.

Southeast Asia and the Pacific

- The region is one of the world's most significant and most threatened centres of biodiversity; its mountain areas are of key global significance.
- Local mountain communities are being depopulated. Rampant poverty and limited local livelihood options – based mainly on subsistence agriculture – lead educated youths to migrate from mountain areas to lowland urban centres in search of off-farm jobs.
- External market forces are causing the depletion of mountain forests, even in remote areas. Legal and illegal logging for timber-based industries and the black market are both highly lucrative.
- Local communities have not received a fair share of the profits from industrial extraction of their mineral and water resources – representing a missed opportunity for local income generation. In addition, this industrial extraction has seriously threatened fragile mountain ecosystems.

Central, eastern and southeastern Europe

- The transition from planned to market-based economies and the creation of new states have been accompanied by territorial disputes, including armed conflicts. These changes have also triggered a number of environmental degradation processes, compromising the future development of mountain areas.
- New institutions relevant to sustainable mountain development have been established – in particular the Carpathian Convention, based on the model of the Alpine Convention. However, these institutions still lack the power of effective implementation.

European Alps


- Overall, the European Alps are an example of a mountain region that has profited from political stability and economic development, including the more recent phenomenon of “amenity migration”.
- Over the last 20 years, transfer payments based on the principle of equity have secured people's prosperity at different levels. Nevertheless, major changes have occurred, for example regarding land use, resulting in an overall reduction in the number of farms and farmers.
- The region is characterized by a rich institutional landscape that has supported development. Nevertheless, the gap between prosperous and peripheral areas has increased.
- Pressure on land resources (e.g. consumption of land for residential purposes) has further intensified, as have factors detrimental to the environment, such as noise, air and light pollution.
- Many remote mountain regions are losing their younger populations, who are an important resource and asset for the future.
- Expanding peripheral urban centres are drawing human resources and natural resources from mountains. Mountain areas must increasingly compete for services and investment on an uneven playing field.

Shortcomings of sustainable mountain development over the past 20 years

From a broader comparative perspective, a range of common shortcomings has been identified vis-à-vis sustainable mountain development. These shortcomings particularly relate to a lack of:

- involvement, active participation and ownership on the part of local stakeholders/civil society in shaping the development of their respective mountain region;
- an integrated (“multi-sectoral”) approach to funding sustainable mountain development, especially by national governments and multilateral financing agencies;
- implementation of the payment for ecosystem services (PES) principle as a sustainable funding mechanism for mountain systems – so far, limited payment for ecosystem services schemes have shown mixed results, and establishing fair benefit-sharing arrangements remains a challenge;
- targets, appropriate indicators, measurements, reliable data and applicable systems for monitoring and steering sustainable mountain development at all levels;
- clear resource-ownership arrangements that recognize and empower local mountain communities, acknowledging their role as custodians and caretakers of resources that are vital to humanity as a whole;
- capacity and capacity development, incentives, knowledge and appropriate institutions to shape and implement specific local, national, regional and global mountain agendas;
- global awareness of the impacts of climate change on mountains, which, despite being similarly affected and vulnerable, have received less attention than the impacts on forests, oceans and coastal areas;
- adequate responses and mechanisms to counter the negative impacts of out-migration and climate change, to address national and transboundary water management issues (including hydropower) and to address the environmental and human impacts of mining operations;
- recognition of the complex problems facing mountain communities, including low incomes, poor health services, food insecurity and malnutrition, poor education and technical skills development, high dependence on the natural environment, insecurity and physical vulnerability as well as drudgery.



A scenic landscape of a mountain valley. In the foreground, a calm blue lake reflects the sky. The middle ground is filled with a dense forest of tall evergreen trees. In the background, a steep, rocky mountain peak rises, partially covered in green vegetation. The sky is clear and blue.

2

Mountains matter for *The Future We Want*



Places of hope and concern

The global importance of mountains is often neglected or overlooked. Mountains provide vital ecosystem services and goods to many people, including those living outside mountain areas. Mountains' crucial role must be acknowledged when promoting sustainable development.

La Paz, Bolivia. (Sabine Brüscheiler-Muster)

Mountains play a key global role

At present, however, mountain areas are often treated as peripheries, and the people who live there are marginalized. Following the Earth Summit in Rio de Janeiro in 1992, several concrete national mountain policies were in fact developed. But very few of them triggered significant positive changes. Overall, investment in the social, environmental and economic capital of mountain areas remains far below what is needed.

In addition, globalization, climate change and demographic growth are increasingly causing profound changes in mountain areas, with negative impacts such as poverty, natural hazards, land degradation, outmigration and food insecurity on the rise. These impacts are further exacerbated by human conflicts in many mountainous regions, placing people's livelihoods in even greater jeopardy.

A global perspective on mountain assets and challenges

Mountains ...

- cover 27 percent of the Earth's land surface.
- are home to 12 percent of the world's population, with many of these people living in majestic yet harsh, even inhospitable, environments.
- host key resources such as minerals, timber and the plant genetic resources of major crops.
- are key tourism destinations.

However, mountains also ...

- are home to one-quarter of the world's poorest and hungriest people, who require special efforts to lift them out of poverty.
- are very sensitive to climate change, which has already affected them markedly.

- are bellwethers of change, as evidenced by rapid glacier melting and loss of snow cover, for example, whose implications extend far beyond the boundaries of mountain areas.
- exhibit widespread land degradation that endangers people's livelihoods and triggers natural disasters that also affect lowland areas.

Mountains provide opportunities for regional and global collaboration

While the many countries that encompass mountain areas may feature different population, economic and cultural compositions, they frequently face similar challenges. Mountain systems often span national borders and thus present opportunities for transboundary collaboration. Mountain-centred regional and global cooperation can enable the voice of mountain inhabitants to be heard (Figure 2.1).

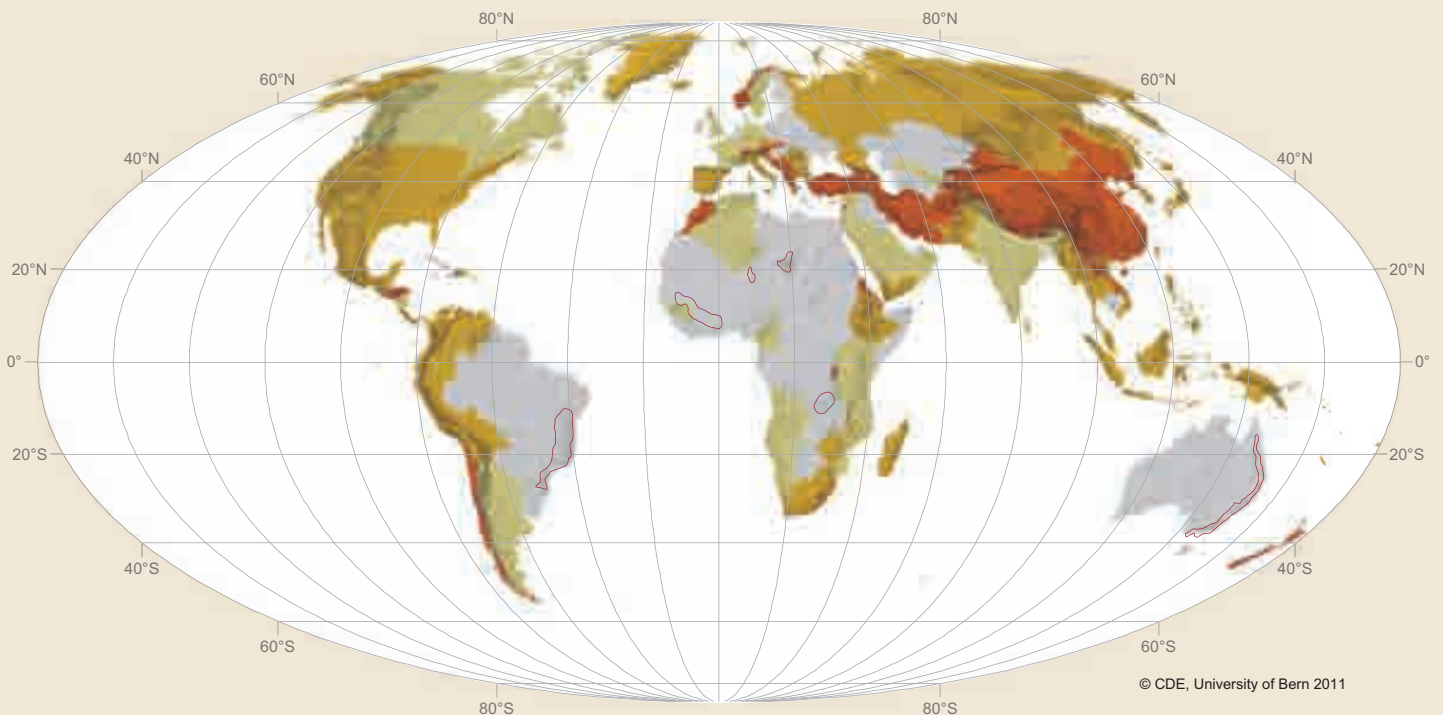
Mountains are ideal arenas for regional collaboration since they ...

- occupy more than half of the national territory of 53 countries and 25 to 50 percent of the national territory of 46 other countries.

Mountains

- cover 27 percent of the Earth's land surface.
- occupy more than half of the national territory of 53 countries and between 25 and 50 percent of the land of another 46 countries.
- are home to 12 percent of the world's population.
- are extremely diverse in human cultures.
- host multiple sacred sites.
- attract between 15 and 20 percent of global tourism, the world's fastest-growing industry.

Figure 2.1: Global mountain territory



Percentage of mountainous area per country

- | | |
|--|---|
| 50 – 100 % | 10 – 25 % |
| 25 – 50 % | 0 – 10 % |
- with important mountain area

Map scale: approx. 1:200,000,000

Map Sources

Terrain data: resampled from GTOPO30, produced by US Geological Survey (USGS)

Administrative: ESRI Data and Maps

Map projection: Mollweide

Map authors: Sebastian Eugster, Thomas Kohler and Kristina Imbach 2002, CDE, University of Bern

Map compilation 2011: Ulla Gämperli Krauer, CDE, University of Bern

- are critical to numerous countries – even those with few mountains – that rely on mountain goods and services such as freshwater and clean air.
- provide opportunities for transboundary collaboration such as joint road and rail construction, water management, biodiversity conservation and establishment of regional knowledge centres.

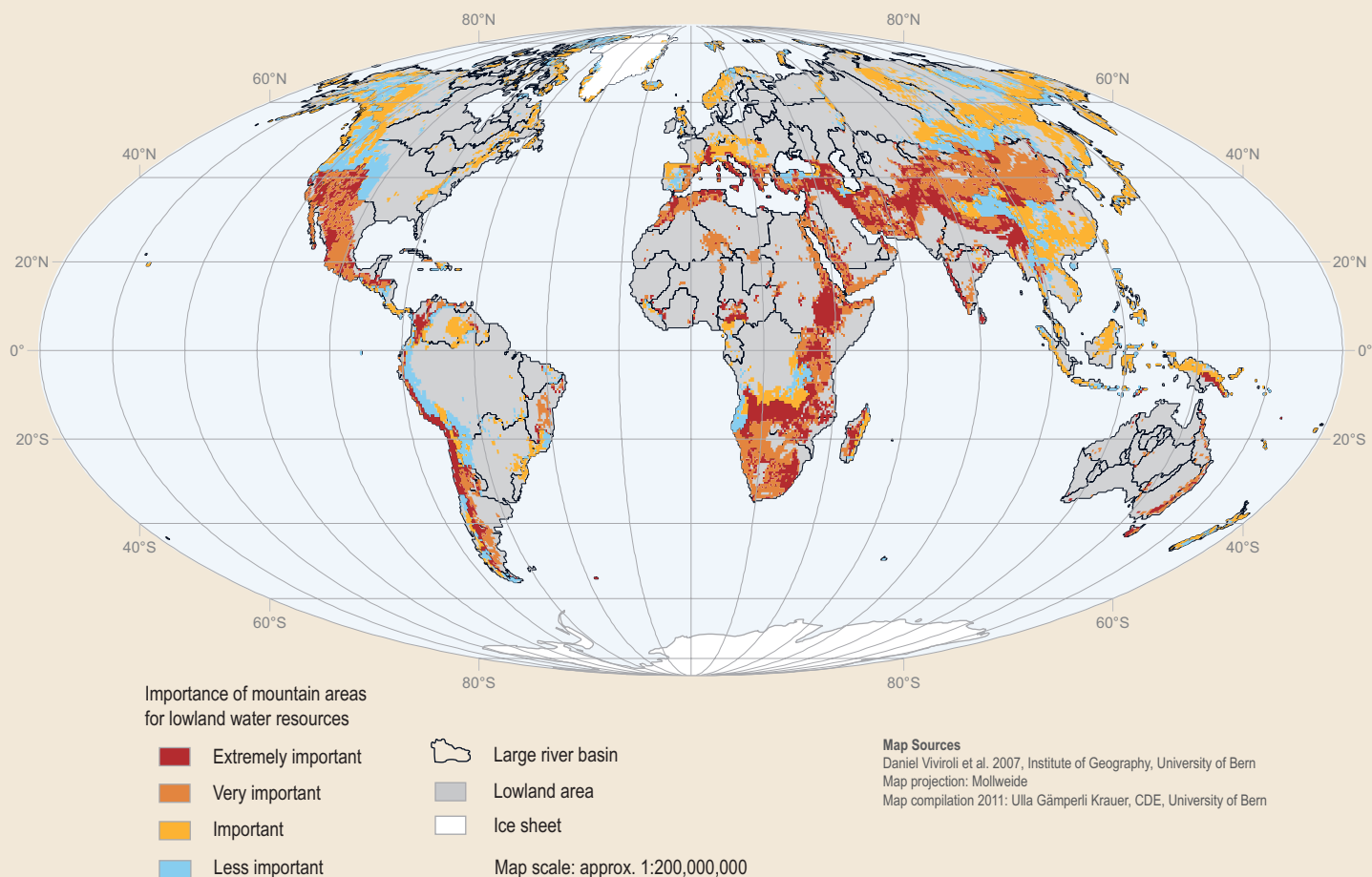
Mountains are the water towers of the world

Water flowing from mountains into rivers is the most important source of green, renewable energy for countless rapidly growing cities and population centres in and around mountains. Climate change may increasingly diminish supplies of mountain water, negatively impacting food security and the world economy. However, global cooperation over water issues could avert such crises. And history suggests that cooperation over water could outweigh conflict: over the last 50 years, 67 percent of all government interactions involving transboundary rivers have been cooperative and only 28 percent have been contentious. Further efforts are needed to sustain or enhance this positive trend concerning the world's 263 transboundary rivers (Figure 2.2).

As key water sources, mountains ...

- provide freshwater to over half of humankind; the 10 largest rivers originating in the Hindu Kush Himalayas alone supply water to over 1.35 billion people (20 percent of the global population).
- are the origin of the world's major rivers.
- contribute 80 to 100 percent of the total runoff from river basins in arid areas where water is extremely important to economic development.

Figure 2.2: Importance of mountain areas for lowland water resources



Mountains

- are the source of the world's major rivers.
- provide freshwater for drinking, domestic purposes, irrigation, industry and hydropower to more than half of humanity.
- hold, in the form of water resources, the world's most important source of green and renewable energy, which supplies rapidly growing cities and centres of population in and around mountains.
- are highly exposed to climate change processes that are expected to cause more frequent floods in some areas and periods of water scarcity in others, with adverse impacts on food security and the development of many mountain regions.

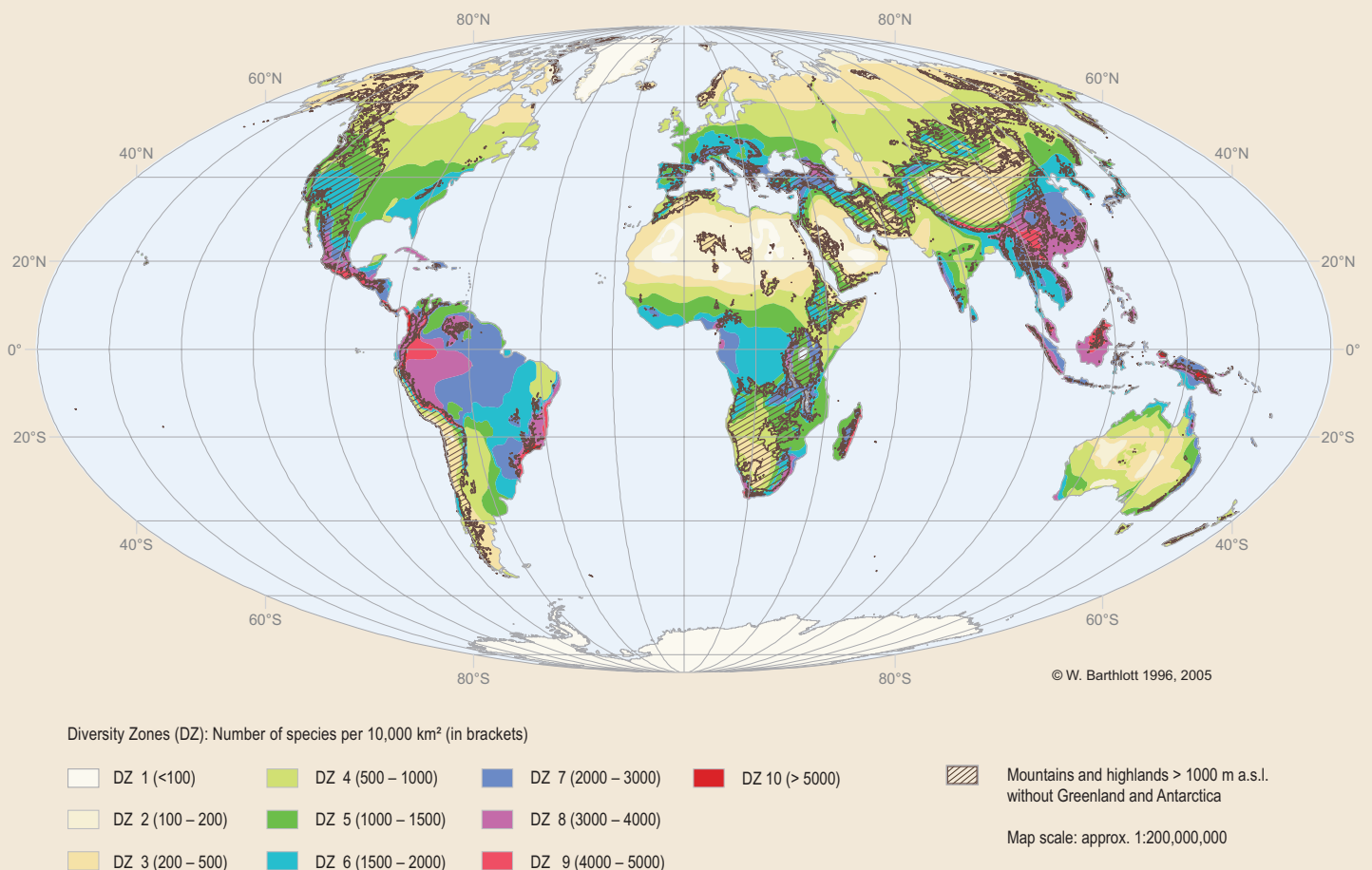
Mountains are hotspots of global biodiversity

Mountains are focal points of global biodiversity, and they host a great variety of locally adapted traditional crops and livestock. This rich heritage represents an important genetic resource needed to ensure global food security. Especially in tropical and subtropical mountain areas, which are often densely populated, additional efforts are required to reconcile protection of biodiversity with the needs of farmers and others whose livelihoods depend on small-scale agriculture (Figure 2.3).

Crucial to biodiversity, mountains ...

- contain more than half of the world's biodiversity hotspots.
- are major centres of biodiversity in the tropics and subtropics: Malaysia's Mount Kinabalu, for example, harbours over 4000 plant species, equalling more than one-quarter of all plant species in the USA.

Figure 2.3: Global biodiversity and mountain regions. Number of species of vascular plants at a regional scale (100x100 km)



Map Sources

W. Barthlott, G. Kier, H. Kreft, W. Küper, D. Rafiqpoor & J. Mutke 2005, Nees Institute for Biodiversity of Plants, University of Bonn

Terrain data: resampled from GTOPO30, produced by US Geological Survey (UGS)
Continental boundary: ESRI Data and Maps

Map projection: Mollweide
Map compilation 2011: Ulla Gämperli Krauer, CDE, University of Bern

- are rich in endemic species: over 50 percent of the mountain plants in Iran, for instance, are endemic (i.e. cannot be found elsewhere).
- have experienced an eightfold increase – over 40 years – in the proportion of their land designated as a protected area, making this one of the fastest-growing types of land use globally.
- host six of eight “Vavilov Centres” of agrobiodiversity for domesticated plants.

Mountains

- host more than half of the world’s biodiversity hotspots.
- provide humankind with essential ecosystem goods and services such as timber, medicinal plants and recreational landscapes.
- are important centres of agrobiodiversity which host a great variety of locally adapted crops and livestock – essential genetic resources for future global food security.

Mountains are a home, a source of income and a place of diverse cultural heritage

Almost a billion people live in mountain regions. They host a variety of cultures that are increasingly threatened by rapid societal change. Many mountain areas are considered sacred places that provide spiritual energy and orientation. Mountains are also important spaces for recreation, presenting opportunities as well as challenges for sustainable mountain development.

Vital sites of habitation and sociocultural meaning, mountains ...

- are home to a disproportionately high share of the world’s poor.
- host a great variety of land-use systems that have contributed to impressive, labour-intensive cultural landscapes such as terraces.
- are considered sacred in many parts of the world: Mount Kailash in China, for example, is worshipped by over a billion people in Asia.
- attract 15 to 20 percent of global tourism, the world’s fastest-growing industry.

Mountains in *The Future We Want*

The global commitment to mountains and the need for sustainable mountain development were first stated in Chapter 13 of *Agenda 21*, the outcome document of the first Earth Summit in Rio in 1992, and re-emphasized twenty years later in the final document of the 2012 United Nations Conference on Sustainable Development.

The Rio+20 outcome document, *The Future We Want*, dedicates the following three paragraphs to mountains:

- We recognize that the benefits derived from mountain regions are essential for sustainable development. Mountain ecosystems play a crucial role in providing water resources to a large portion of the world’s population; fragile mountain ecosystems are particularly vulnerable to the adverse impacts of climate change, deforestation and forest degradation, land-use change, land degradation and natural disasters; and mountain glaciers around the world are retreating and getting thinner, with increasing impacts on the environment and human well-being. (*Paragraph 210*)

Figure 2.4: Mountains connect us all. (Illustration by E. Mantilla-Meluk, Bogotá, Colombia)



- We further recognize that mountains are often home to communities, including indigenous peoples and local communities, who have developed sustainable uses of mountain resources. These communities are, however, often marginalized, and we therefore stress that continued effort will be required to address poverty, food security and nutrition, social exclusion and environmental degradation in these areas. We invite States to strengthen cooperative action with effective involvement and sharing of experience of all relevant stakeholders, by strengthening existing arrangements, agreements and centres of excellence for sustainable mountain development, as well as exploring new arrangements and agreements, as appropriate. (*Paragraph 211*)
- We call for greater efforts towards the conservation of mountain ecosystems, including their biodiversity. We encourage States to adopt a long-term vision and holistic approaches, including through incorporating mountain-specific policies into national sustainable development strategies, which could include, inter alia, poverty reduction plans and programmes for mountain areas, particularly in developing countries. In this regard, we call for international support for sustainable mountain development in developing countries. (*Paragraph 212*)



3

Road map for sustainable mountain development: shaping the new Global Mountain Agenda



Policy principles and policy actions

Mountains provide vital goods and services that benefit all humanity, support sustainable development at the global level and may be used to steer the world towards a greener economy.

Lake Arenal in the mountains of Costa Rica. (Olivier Chassot)

Twenty years after the first Earth Summit in Rio, the challenge of sustaining these mountain-based goods and services is greater than ever before. The global community must act: a new agenda and strengthened institutional frameworks for sustainable mountain development are urgently needed.

Policy principles

This new mountain agenda should be based on the following six policy principles:

Mountain-specific strategies: Mountains face unique global challenges and opportunities in sustainable development, also regarding development of green economies and institutions. Targeted strategies are required for effective action, especially at the national level. Global and regional institutions, conventions and frameworks – such as the United Nations Framework Convention on Climate Change, the United Nations Convention on Biological Diversity and the United Nations Convention to Combat Desertification – must design and implement specific programmes for mountain regions.

Transboundary cooperation, upstream–downstream linkages and rural–urban linkages: Many mountain ecosystems, and the services they provide, go beyond national borders. Typically, lowland areas absorb most of the benefits from mountain ecosystems. To increase the effectiveness of relevant interventions, transboundary and upstream–downstream collaboration should be strengthened. Opportunities for partnerships and collaboration are naturally provided by the increasing economic interdependency of rural and urban areas, both within mountain areas and between them and lowland cities and metropolitan areas.

Inclusive governance and institutions: The success of *Agenda 21* – in guiding future sustainable development – will depend on the involvement of all relevant stakeholders. Mountain populations and stakeholders from government, private and civil society organizations must be involved in all decision-making stages, from planning to implementation and outcome monitoring.



Figure 3.1: Mountains balance our climate and life. (Illustration by E. Mantilla-Meluk, Bogotá, Colombia)

Compensation for ecosystem goods and services: Ensuring that mountain populations receive full compensation for the ecosystem goods and services they provide will enhance local livelihoods and reduce poverty in mountain areas, and safeguard the sustained flow of these goods and services for the benefit of all.

Balancing conservation and development: Mountain ecosystems are often fragile, and protecting their integrity is key to securing the provision of critical goods and services. However, for reasons beyond the control of local populations, the development of mountain areas frequently lags behind that of other regions. Mountain areas are often the site of unsustainable investments and damaging extractive industries. While difficult, finding a balance between conservation goals and development goals is crucial. This can be achieved, in part, by combining cutting-edge global know-how with sound local and regional practice and targeted investments.

Coherence with principles of international cooperation: Collective action in support of mountains must be consistent with existing and evolving principles and norms of international cooperation. These include, among others: the principle of common but differentiated responsibility; principles of intra- and intergenerational equity; the precautionary principle; duties to prevent transboundary harm; duties to protect the rights of women, men and children; and duties to protect indigenous people and their traditional knowledge and culture.



Peaks of Cordillera del Paine, part of Torres del Paine National Park, Chile. (Monika Eugster)

Policy actions

Sustainable Mountain Development Goals (SMDGs)

Specific strategies tailored to mountain contexts are required for effective policy action, including investments in the development of green economies and institutions. Individual nations and regional bodies are encouraged to design specific Sustainable Mountain Development Goals (SMDGs) within the framework of broader Sustainable Development Goals (SDGs). These should identify priority objectives and implementation plans, engage local mountain communities and include green investment, institutional development and capacity building. These should also include approaches designed to actively engage local mountain communities in implementation.

Water resource management

Given mountains' key role in providing water for domestic and commercial use, ensuring food security and supporting green energy, national and regional bodies must develop integrated water resource management strategies. These strategies should be based on a multidisciplinary approach that embeds sectoral policies and action within the overall goal of sustainable development; combines top-down and bottom-up approaches; and secures long-term planning and financing, capacity development and institution building.

Green investments

Mountain regions bear great potential for greening economies within and beyond their borders. In order to make full use of this potential in a sustainable way, individual countries should tap existing national and international finance mechanisms, explore partnerships with the private sector and design green investment plans for mountain regions. Priority areas include provision of green energy based on sustainable hydropower generation; responsible mining and resource extraction; investment in basic infrastructure; and promotion of small and medium-sized industry, (eco)tourism, sustainable agriculture and enterprises based on (agro)bio-diversity.



Terelj region, Mongolia. (Hanspeter Liniger)

Climate change adaptation

Climate change is already affecting mountain ecosystems, production systems and related livelihoods. The need for coordinated efforts to support measures of adaptation to the expected impacts at the local, national and regional scales is widely recognized. At the country level, the implementation of national adaptation programmes requires careful consideration of appropriate strategies for mountain areas and the inclusion and participation of mountain communities. Even in lowland areas, future land-use and development planning must anticipate and properly address the social and environmental effects of climate change in mountains in order to be effective. This is of particular relevance at the transboundary level. Adequate funds need to be earmarked for adaptation measures in mountain areas. These measures should build capacity in the use of new technologies, encourage the exchange of mountain-specific traditional and innovative information and systems for sound decision-making, and establish appropriate information baselines and monitoring systems.

Disaster risk management

Mountains are particularly vulnerable to the effects of natural disasters, such as avalanches, mudflows, floods, landslides and earthquakes, with consequences that often extend far beyond mountain regions. Individual countries are advised to prepare mountain-specific disaster risk management plans that integrate risk assessment, prevention, response and recovery. These plans could contain elements of a green economy, such as sustainable forestry and hazard-resistant road construction. Further, the plans should help restore or establish institutions capable of successfully dealing with hazards and risk management.

Regional centres of excellence

Lack of mountain-specific knowledge and process understanding hinders informed policy-making and effective action at all decision-making levels. Technologies and institutions that work well in lowland areas are often ill suited to mountain realities. There is a need to promote mountain-focused regional centres of excellence that advance research and green technology development, enhance capacity building and institutional growth and generate policy advice tailored to mountain areas.



A tropical landscape featuring several tall palm trees in the foreground and middle ground. In the background, there are misty, green mountains under a bright, slightly hazy sky. A small portion of a traditional house with a tiled roof is visible on the right side. The overall scene is lush and scenic.

4

Regional issues and opportunities for sustainable mountain development



Issues and opportunities in the Andes

Mountain landscape in Peru. (Daniel Maselli)

Why mountains in the Andean region matter

The world's longest mountain chain, the Andes form the backbone of South America and are a major global physiographic feature that influences the climate, seismic energy, biodiversity and human culture and history. Extending approximately 8000 km, the Andes stretch across Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina and Chile. They occupy more than 2,500,000 km² and are home to about 85 million people, 45 percent of the Andean countries' populations combined. The northern Andes are one of the most densely populated mountain regions in the world (Figure 4.1, Figure 4.2). At least 20 million additional people depend on mountain resources and ecosystem services, mainly in the large cities along South America's Pacific coast. One of the most biodiverse regions on the planet, the Andes are vital to Andean countries' economies and the livelihoods of their citizens. But growing populations, changes in land use, unsustainable use of resources and climate change are increasing pressure on Andean mountain ecosystems. This could have far-reaching consequences for the mountains' future ability to provide ecosystem goods and services. To achieve sustainable development, policy action is needed regarding the following: protection of water resources, adherence to responsible mining practices, adaptation to climate change and creation of mechanisms to generate, communicate and use evidence-based knowledge for sound decision-making.

*"The Apus guard the Earth.
When each one of us is born,
the Apu of that place takes
responsibility for our
development." (Inca tradition)*

Apus: Sacred Mountains

How current trends affect sustainable mountain development in the Andes

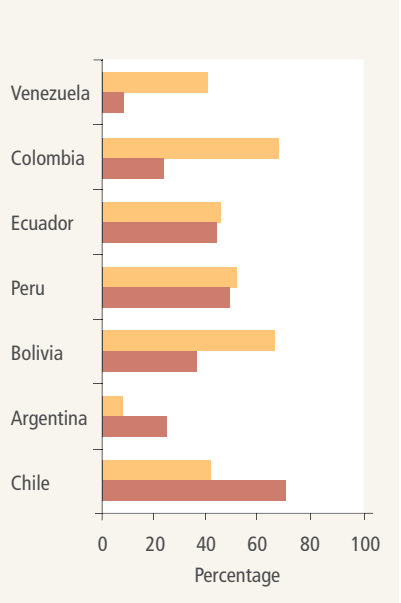
Accounting for a significant proportion of the region's gross domestic product, the Andes are immensely important to the economies of the seven Andean countries. The Andes contain globally important reserves of metals and minerals, large areas of agricultural land and some of South America's largest business capitals. The Andes provide water for agriculture, domestic use and production of electricity. Yet they are also home to some of the region's poorest communities.

The Andes encompass 15 to 17 percent of the total cropland belonging to the seven Andean countries. The extent of the harvested area has remained relatively stable since 1990, but agricultural production has increased by 75 percent over the same period. This large increase in agricultural intensity and yields has been accompanied by incremental growth in the value of agricultural products. In 2009, this economic sector accounted for between 3 and 13 percent of individual Andean countries' gross domestic product.

Mining of minerals has increased in the Andes, with the mining sector gaining in economic importance since 1990. But mining's importance to the region's national economies contrasts with that of agriculture: mining generally employs fewer people, contributes less to the gross domestic product, yet accounts for a large proportion of total exports. In Peru, for example, mining contributed 4.1 percent of the gross domestic product in 2010, but accounted for 70 percent of exports, with metals, mainly from the Andes, making up 61 percent. At the same time, less than 1 percent of Peru's working population was directly employed by the



Figure 4.1 (left): The Andean region
 Figure 4.2 (below): Proportions of each country's area (brown) and population (yellow) belonging to the Andean region



mining sector; including service industries related to mining pushes that figure to 3 percent. But this is a very small percentage compared with agriculture, which employs approximately 30 percent of Peru's population. In addition, mining's environmental and social impacts have been and remain the subject of controversy and debate in the region.

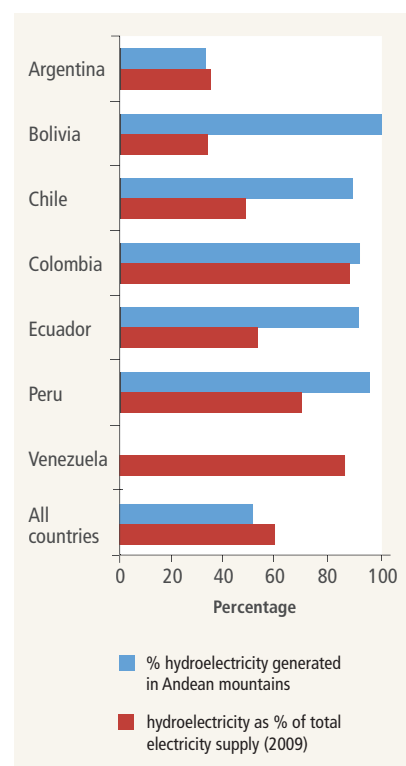
In the northern Andes, mining activities are concentrated in Peru and Bolivia. Extensive areas of land have been granted as concessions in Colombia and Ecuador, including parts of national parks in the latter. In all four countries, large areas of mountain forest are affected by mining concessions. Up to 75 percent of Ecuador's humid forest falls within mining-concession areas. While only a small area of each concession is actually subject to mining, there are often far-reaching consequences stemming from mining-related pollution, the opening of previously undisturbed areas and changes in local social and economic dynamics. Related conflicts over resources, especially water, are increasingly common. Mining projects in Argentina and Chile have destroyed glaciers, stirring up controversy. Overall, even though mining has been an important factor in Andean countries' development over the last 20 years, investment in extraction activities has failed to generate broader social and economic benefits in the areas directly affected by mining exploitation.

High mountain ecosystems in the Andes play a fundamental role in the storage, regulation and provision of water to local communities, agriculture, large cities and industry. These services are provided by the *páramo* and humid *puna* ecosystems in the north of the region, while glaciers have increasing hydrological relevance towards the south. But these systems are fragile and their water regulation properties are vulnerable to land-use change and global warming, with direct implications for biodiversity, water and energy supplies. Currently, with the exception of Argentina and Venezuela, mountains provide over 85 percent of Andean countries' hydropower, which contributes significantly to their total energy supply (Figure 4.3).

As a result of climate change, temperatures in the southern Andes are expected to increase and precipitation is likely to decrease. However, estimates of future precipitation in other areas of the mountain range are subject to a high degree of uncertainty, mainly owing to the complex topography, lack of data on current climatic processes and because precipitation patterns will heavily depend on changes in El Niño that are not yet well understood. As in other regions, global warming is expected to drive changes in ecosystem composition and structure according to elevation gradients, with plant and animal species migrating to higher, cooler sites. Mountaintop *páramos* and cloud forests in the northern Andes are considered the most vulnerable ecosystems to climate change in the Andes. But glacier retreat has been observed along the entire mountain range. Many of the region's glaciers have disappeared completely in recent decades. The Cordillera Blanca of Mérida, for example, lost an estimated 87 percent of its glacier cover in the last 50 years. And between 2000 and 2005, there was a doubling in the rate at which Patagonian glaciers are contributing to sea-level rise. Glacier loss threatens provision of drinking water and hydropower to cities in Peru, Bolivia, Argentina and Chile. It also has consequences for agriculture in Andean valleys. Landslides, floods and resource conflicts could increase as climate change affects hydrological patterns and water availability in the region.

Several watershed management projects have been launched in Andean countries over the last 20 years. These aim to secure water reserves and provision, reduce poverty and improve environmental conditions. In some cases, the projects have led to integrated water management policy. More recently, Andean policy-makers have begun to introduce mechanisms that provide economic incentives for protection of environmental services (e.g. payment for ecosystem services), in hopes

Figure 4.3: Generation of hydropower in the Andes





Lauca National Park, Chile. (Monika Eugster)

of mitigating and adapting to climate change effects. Other promising ways of adapting to climate change can be found in the region's high agrobiodiversity and traditional farming systems – dating to pre-Columbian times – which were developed to cope with short- and long-term environmental change and uncertainty.

Mountain areas in the Andes have been fertile ground for innovation in local governance. Examples include concrete policies of decentralization and citizen participation. The Andean Community, a political organization formed by four Andean nations (Bolivia, Colombia, Ecuador, Peru), also provides a regional framework for addressing issues of sustainable mountain development.

Nevertheless, population growth, changes in land use, unsustainable exploitation of resources and climate change are increasing pressure on the Andes. Solutions to these challenges are needed that protect people's livelihoods, ensure water supplies and maintain a healthy environment. Achieving sustainable development in the Andes will require broader regional efforts that extend beyond the borders of mountain areas. Unless major policy changes are introduced, resource use and development in the Andes will become increasingly unsustainable, with serious consequences for the region's economies, societies and the environment.

Policy action for the Andes

Policy action for the Andes must occur at the regional, national and local levels. Regional integration, emphasizing the importance of mountain issues, should be promoted within the Andean Community and, eventually, within the Union of South American Nations. An especially important function of these organizations is to create a common regional platform for strengthening the position of mountains in international conventions (e.g. United Nations Convention on Biological Diversity, United Nations Framework Convention on Climate Change, United Nations Convention to Combat Desertification). At the national and local levels, actions should focus on drafting and implementing specific strategies (e.g. ecosystem protection, responsible mining, green economy efforts) and on innovative institutional mechanisms that place mountain issues on the political agenda. The following list outlines recommended policy actions.

Protect mountain ecosystems to safeguard water supplies. This includes actions such as introducing strategies to conserve mountain ecosystems (*páramos*, wetlands, *puna*); lobbying for legal protection (e.g. laws defining no-go mining zones, protected areas); and strengthening upstream–downstream partnerships to encourage basin-wide responsible use of resources.

Promote agriculture in mountain areas by building on local knowledge and native products, while improving food security and protecting biodiversity. This includes actions such as raising awareness of women’s crucial role in Andean agriculture and local food security, and providing incentives for projects that combine environmental protection with increased agricultural production.

Implement mountain-focused climate change adaptation measures that span regional, national and local policies. This includes actions such as supporting research and monitoring efforts that enable evaluation of upland ecosystems’ (e.g. wetlands, glaciers) current and future contribution to overall water supplies (accounting for different climate change scenarios); developing and implementing ecosystem-based adaptation approaches; and enhancing management capacity and approaches regarding disaster risk reduction.

Transform current mining methods with responsible mining codes. This includes actions such as formulating responsible-mining policies that incorporate recyclability at all stages of production, within and beyond the mining region.

Use regional cooperation to share and replicate successful decentralization efforts that increase citizen participation and benefit sustainable mountain development. This includes actions such as implementing innovative governance mechanisms that enable stronger representation of mountain communities in national and regional decision-making.

Improve coordination between educational and academic institutions (e.g. state universities in mountain areas, research NGOs) and governments to ensure that knowledge generated is applied in sustainable mountain development. This includes actions such as aligning research agendas with mountain areas’ specific development needs, documenting traditional knowledge and innovative community efforts, and integrating them with the latest science to generate actionable solutions on the ground.

Improve communication and coordination mechanisms within governments. This includes actions such as identifying overlapping jurisdictions between government departments and between government levels (e.g. national, municipal) as well as implementing multi-level approaches.

Implement decision support systems at the local and regional levels, addressing issues such as water management and climate change adaptation. This includes actions such as supporting capacity development regarding use of new technologies in mountain regions and incentivizing generation and exchange of mountain-specific information for sound decision-making.

Extracted from: Devenish, C. & Gianella, C., eds. 2012. *Sustainable Mountain Development in the Andes: From Rio 1992 to 2012 and Beyond*. Lima, Peru: Consorcio para el Desarrollo Sostenible de la Ecorregión Andina (CONDESAN). 66 pp.



Issues and opportunities in Meso-America

Oak forest in Los Santos, Cerro de la Muerte, Costa Rica. (Olivier Chassot)

Why mountains in Meso-America matter

Mountains in Meso-America cover 25 percent of the region (Figure 4.4). Remarkably, they account for 12 percent of the Earth's biodiversity while encompassing only 2 percent of its land surface. A total of 86 major indigenous ethnic groups occupy 54 percent of Meso-America's mountain territories. These territories encompass 25 distinct mountain systems, which are home to tropical and subtropical forests, deserts and xeric shrublands. Climate change represents the greatest global threat to sustainable mountain development in Meso-America. Other threats include mining, expansion of hydropower generation, urban encroachment into mountain areas, deforestation, soil erosion and high-elevation monoculture practices.

Meso-America stretches from Mexico's Tehuantepec Isthmus across Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama, covering a total of 862,468 km². Since Rio 1992, Meso-America has been buffeted by an increasingly complex international situation, characterized by the destructive geopolitics of drug trafficking and efforts to combat it, growing vulnerability of the region's least-developed countries in the global economy, and high international oil and food prices. These factors have compounded historical constraints on socio-economic development in the region. Despite regional gains in political stability, these dynamics have hampered rapid advances in human development and regional integration. The challenges facing the region demand not only innovative and bold regional and national responses, but also major improvements in the region's collective capacity to implement such responses.

"Only by a marvel, only by magic art was the formation of the mountains and valleys; and instantly cypress and pine trees sprouted up together on the surface." (Popol Vuh)

How current trends affect sustainable mountain development in Meso-America

Today, the vast majority of the region's over 50 million people lives in the lowlands of the Pacific coast. However, Meso-America also features a high concentration of large cities in central valleys that increasingly depend on water from the mountains. Climate change and accelerated population growth – the region's population has doubled since 1992 – jeopardize the health of regional ecosystems and the economic and social capital they support. At the same time, forests, state-protected areas, biological corridors for connectivity conservation and indigenous territories cover 72.6 percent of the region's mountainous terrain. In contrast to the densely populated, industrialized lowlands, Meso-America's sparsely populated mountain areas present a regional opportunity to strengthen conservation and sustainable development.

Rapid population growth is a primary source of increasing pressure on the region's natural resources. Meso-America's population has grown from 11 million in the 1950s to more than 50 million today. Much of the regional economy relies on extractive use of mountain natural resources. Energy production from renewable resources within protected mountain areas is expanding, particularly hydropower and geothermal energy production. Challenges for sustainable mountain development in Meso-America include: mitigating climate change and adapting to its impacts; providing jobs, health care and education services; reducing dependency on food imports and achieving food security; managing outmigration; stabilizing democracy; fighting corruption; strengthening local government; protecting the region's natural heritage; and supplying clean energy. The magnitude of these challenges means that no single country in the region can tackle them alone. Close and effective regional collaboration is crucial.

Figure 4.4: Meso-America's mountain areas



The challenges facing the region's mountains have not changed dramatically since 1992, but some regional progress has been made regarding the quality of natural resource data and information sharing. This has improved the existing knowledge base on sustainable agricultural technologies and conservation practices within local communities, and provided baseline data for mountain risk-reduction actions. There has been an increase in the number of efforts towards, and successes in, promoting integrated watershed management, supporting alternative livelihood opportunities (e.g. sustainable tourism) and enhancing infrastructure and social services. Issues that have yet to receive adequate attention include land-use planning, risk management and early-warning systems.

There have been notable advances in the promotion and creation of policy instruments for integrated management and conservation of Meso-America's mountain environments. Over the last twenty years, virtually all Meso-American countries have either established or strengthened their respective ministries of the environment and natural resources, drafted national environmental laws, set up national biodiversity strategies, developed networks of protected areas and signed international environmental treaties and conventions. Schemes such as payment for ecosystem services, ecological restoration and connectivity conservation have emerged as promising options for sustainable mountain development and trans-boundary cooperation in Meso-America's current sociopolitical and environmental context.

Policy action for Meso-America's mountains

The Mesoamerican Biological Corridor (MBC) represents the region's best opportunity to implement sustainable mountain development, provided the Central American Integration System and its Central American Development Commission (SICA-CCAD) receive strong backing from all eight countries in the region. Biological corridors are particularly relevant as a planning and management tool for use in linking mountain areas with densely populated lowland areas, at both the regional and continental scales. Such links may also enhance cultural appreciation for mountains among all the region's populations. At present, the Mesoamerican Biological Corridor covers only a little under 17 percent of Meso-America's mountain areas, so there is ample room for increasing connectivity (Figure 4.5). The project continues to face many challenges, but its administrative structure has been consolidated, enabling the eight countries to jointly plan and evaluate progress. Recommended policy actions to support ongoing efforts are listed below.

Further strengthen the institutional setting for the Mesoamerican Biological Corridor. Efficient coordination, dedicated leadership and sufficient funding are required to ensure broad regional participation in the Mesoamerican Biological Corridor and its effective operation.

Support and empower local organisations. Strong local organisations are vital to achieving success on the ground.

Build on successful strategies. Costa Rica's model of connectivity conservation and management, for instance, could be replicated and adapted elsewhere in the region.

Institutionalize regional initiatives. Ongoing efforts need to be strengthened and pooled. Regional initiatives based on alliances between national governments and civil society should be institutionalized.

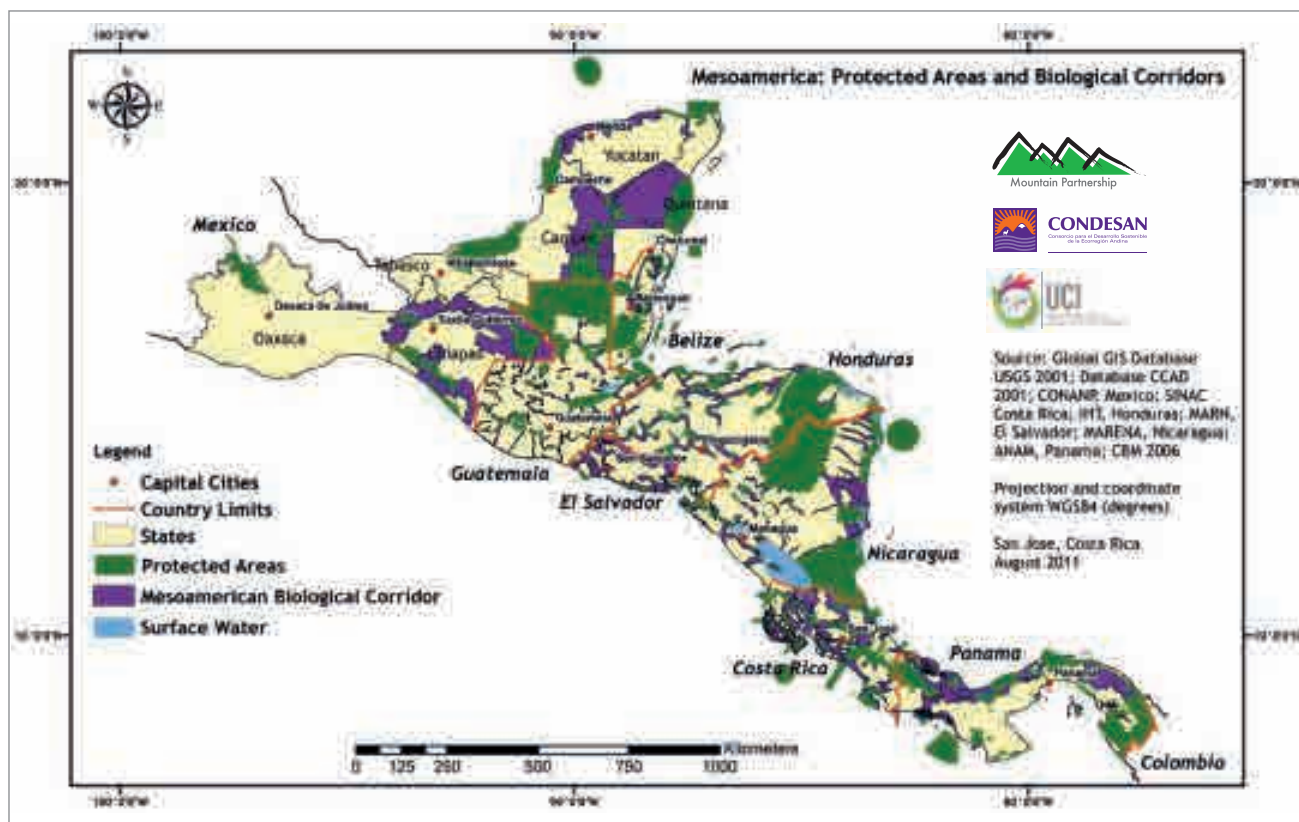


Figure 4.5: The Mesoamerican Biological Corridor

Expand mountain connectivity landscapes. Efforts to design additional mountain connectivity landscapes should be continued and expanded, with a view to filling conservation gaps and promoting sound land-use planning.

Cultivate appreciation for mountains. Mountains must become an integral part of local, national and regional agendas in Meso-America.

Create an inter- and multidisciplinary mountain institute. There is an urgent need to establish an inter- and multidisciplinary mountain institute in order to foster a mountain identity in the region. Such an institute would also be instrumental in supporting and steering government action towards sustainable mountain development in Meso-America.

Extracted from: Chassot, O., Valverde, A., Jiménez, V., Müller, E. & Moreno, T. 2012. *Sustainable Mountain Development in Meso America: From Rio 1992 to Rio 2012 and Beyond*. San José, Costa Rica: Latin American School for Protected Areas (ELAP), University for International Cooperation (UCI), Tropical Science Center (TSC). 96 pp.



Issues and opportunities in North America

Yosemite National Park, USA. (Jürg Krauer)

Why mountains in North America matter

Mountains in Canada, the United States and Mexico include approximately 280 ranges and associated subranges and cover nearly 36 percent of the region's land mass (Figure 4.6). Both Canada and the United States feature extensive national park and wilderness lands that encompass a significant amount of mountainous terrain. These protect ecosystems as well as sacred sites valued by Native Americans and others. Through land and conservation trusts, the United States have created conservation "easements", a concept that is taking hold globally. In 2010, Canada created a public-private agency to protect more than 157,000 hectares of Boreal forest, which includes a significant area of land in the Laurentian and Appalachian Mountains. The region's mountains are a primary source of freshwater and other natural resources, such as coal and natural gas, which are pillars of North American energy economies. The recreation and tourism industry – the lifeblood of many mountain communities – contributes significant revenues to state and provincial budgets. And for many people in the region, mountains provide solace and a sense of spiritual connection to nature, and are treasured as sites for recreation. Nevertheless, despite vigorous local and regional efforts towards preservation, North America's fragile mountain ecosystems face major challenges stemming from climate change, urban encroachment and extractive industries.

How current trends affect sustainable mountain development in North America

Water emanating from North America's mountains is crucial to satisfy regional demand. The city of Los Angeles, for example, could not exist without water flowing from the Rocky Mountains. Currently, negotiations are underway to ensure water rights in the Colorado River on behalf of Mexico. However, evidence of extensive and rapid glacier retreat (Figure 4.7) in the past century raises concerns about the threats posed by global warming to mountain water sources and future water supplies.

"I was standing on the highest mountain of them all, and round about beneath me was the whole hoop of the world. And while I stood there I saw more than I can tell and I understood more than I saw; for I was seeing in a sacred manner the shapes of all things in the spirit, and the shape of all shapes as they must live together like one being."
(Black Elk, Oglala Lakota (Sioux), 1863–1950)

The North American West is heating up faster than the global average: Between 2003 and 2007, the average global temperature was 0.55 °C higher than the 20th-century average; but average temperatures in 11 western US states were almost 1 °C higher – 70 percent higher than the global average. In addition to getting hotter, the North American West is getting drier; there is evidence of decreased regional snowpack and snowfall, earlier snow melt, more winter rain events as well as increased peak winter flows and reduced summer flows in the Colorado River and its tributaries – the primary sources of water in the western United States. Water shortages have reached the point where cities such as Los Angeles, Las Vegas and Phoenix have acquired all possible water-use rights in the Colorado River system, extending all the way to the Colorado Rockies. In some cases, entire watersheds in mountains are being earmarked as water supplies for megacities. The best example is New York City, which acquired land in a major watershed in the Catskill Mountains and established a partnership with all mountain stakeholders in the area. It seeks to regulate land use and ensure that the best

Figure 4.6: North America's mountains



management practices are implemented in areas that remain under private holdings, thus guaranteeing safe long-term water supplies to New York City.

The prevailing drier and warmer conditions are also driving important ecological changes in the mountains of western North America. Wild plant and animal species are migrating to higher altitudes. The distribution range of certain pests, including pine beetles, is expanding and outbreaks are increasing in frequency. Marked shifts in the natural timing of the seasons are causing certain wild species to bloom or hatch earlier. Significant changes in forest fire regimes are also associated with the higher regional temperatures. From 1987 to 2004, there was a 78-day increase in the length of the fire season, a fourfold increase in the number of fires, a fivefold increase in the time needed to put out the average wildfire and a near sevenfold increase in the total area burned.

In North America, the perceived quality of life available in mountain areas attracts both retirees and younger people. Many mountain areas are seen as being rich in natural and cultural amenities. So-called amenity migrants move to the mountains, whether part-time or permanently, to enjoy their seemingly superior



Figure 4.7: Glaciers are retreating rapidly in the mountains of North America. For example, in 1850, a total of 99 km² of Glacier National Park, Montana, was covered by glaciers. By 1993, only 27 percent of that glacier coverage remained. The park's larger glaciers are now about a third of their former size, as recorded in 1850. Numerous smaller glaciers have disappeared completely. The photographs to the left illustrate changes in the area covered by the Grinnell Glacier in Glacier National Park

Upper left: 1938 (T. J. Hileman, Glacier NP archives)
Upper right: 1981 (C. Key, U.S. Geological Survey (USGS))
Lower left: 1998 (D. Fagre, USGS)
Lower right: 2009 (L. Bengtson, USGS)



Sawtooth Mountains from Salmon River, Idaho, USA. (Matthias Kohler)

environment and distinct culture. Tourism to many high-amenity mountain areas is increasing, and economies that once relied on natural resource extraction are giving way to amenity economies, in which communities try to attract businesses and thus enlarge their tax base. The American mountain towns of Aspen and Durango, in Colorado, are good examples of places profiting from this new amenity economy “boom”. Many there see amenity migration as an important change agent, and some communities consider it in their planning and decision-making processes. At the same time, certain high-profile resorts and resort towns – such as the Aspen Skiing Company and Telluride – have taken the opportunity to promote sustainable mountain development via progressive climate change policies, strict environmental and development codes, elimination of coal dependency, education, political advocacy, films and media efforts.

Nevertheless, the biodiversity present in North America’s mountain ecosystems is being affected by the rapid growth of populations and tourism in the region’s mountains and valleys. Generally accompanied by new infrastructure such as reservoirs, roads and fences, much of this growth and development is occurring in the valleys and foothills that provide key winter habitat or movement corridors for seasonal migrations of native fauna. Barriers are being created that block or constrain essential seasonal movements of wildlife. Among other effects, fauna fitness can decline due to the isolation and inbreeding caused by the fragmented landscape.

Mining is an important economic driver in North America’s mountains, but its negative impacts are often profound. Most extraction processes use toxic chemicals (e.g. cyanide, arsenic) that create poisonous runoff. Tailing ponds, intended to contain the poisonous runoff, often fail, leading to serious downstream damage to land, water and people. Mountaintop removal coal mining, devised in the 1970s, is a very destructive mining method being used in America’s Appalachian Mountains. It involves removing 200 m or more of a mountain summit to get at buried seams of coal; the excess earth is dumped in neighbouring valleys. In 2001, mountaintop removal in the Appalachian coal basin accounted for less than 5 percent of the United States’ coal production; meanwhile, based on the extraction



Mountaintop removal in West Virginia, USA. (Vivian Stockman, Flyover courtesy SouthWings.org)

rates in 2000, the region's reserves of high-quality, thick bituminous coal were predicted to last no more than twenty years. Thus, mountaintop removal is destroying one of America's national treasures – the Appalachian Mountains – to satisfy a mere fraction of the nation's current and future energy needs. It has levelled over 500 mountaintops; buried or significantly damaged almost 3220 km of streams; caused ecological damage to over 2070 km² of one of North America's most biodiverse regions; and had devastating effects on nearby homes and communities. Mountaintop removal operations increase flooding risks, dry up an average of 100 wells per year and contaminate still more. Blasting from these operations can crack the foundations and walls of houses, while sending boulders flying hundreds of yards into roads and homes.

Coal companies increasingly use mountaintop removal because it enables almost complete recovery of coal seams and requires far fewer workers compared with conventional methods. In the early 1950s, there were between 125,000 and 145,000 miners employed in West Virginia. In 2004, there were just over 16,000 miners, yet actual production of coal increased over the same period. Studies show that counties with a high percentage of mining jobs tend to have high levels of poverty and overall unemployment. The highest levels of poverty are found in the region's more rural communities and in counties with higher coal production. Further, in Kentucky and West Virginia, taxpayers have been found to lose hundreds of millions in annual tax dollars because the states spend more subsidizing coal production than they receive in coal revenues.

Few consumers see a connection between flipping a light switch and blasting some of the world's oldest mountains. In 2009, citizens and legislators in several states set out to change that. In unprecedented moves, the United States' top two consumers of coal from mountaintop removal – Georgia and North Carolina – introduced bills banning the use of mountaintop-removal coal mined in their states. In the meantime, eight other US states and the District of Columbia have taken similar action.



Grand Canyon, USA. (Jürg Krauer)

High-volume hydraulic fracturing – or fracking – is an increasingly popular method of extraction used in North America to access deposits of natural gas, which many consider a clean energy alternative to coal and oil. Fracking involves injecting millions of gallons of water, chemicals and sand into shale rock formations deep underground, at pressures high enough to break open the rock and release the gas. However, in addition to concerns about depleting local water supplies, fracking produces hazardous wastewater just like coal mining. There have been over 1000 documented cases of water contamination near fracking sites in the United States.

Policy action for North America's mountains

The challenges to sustainable mountain development in North America are many. The following policy actions can help overcome problems, strengthen ongoing efforts and achieve further progress.

Harmonize and coordinate efforts to promote sustainable development, in mountains and elsewhere. Most inroads towards promoting sustainability have been made by public and private organizations at the local and regional levels. For example, the governments of Canada and the United States have both considered introducing federal laws meant to address climate change, but the corresponding legislation in both countries is neither comprehensive nor certain to pass. In the absence of adequate federal programmes, US states and Canadian provinces have launched their own climate change initiatives. Not surprisingly, however, federal, state and provincial governments disagree about the best measures to control greenhouse gases, even when they agree on the broader objective. Policy actions at the regional and national levels are needed to harmonize efforts and create legal coherence.

Strengthen collaboration between the region's mountain areas. Despite numerous partnerships and agreements, North America lacks a cohesive strategy to determine the current and future development of the region's mountains. Given the diverse peoples, cultures, values, economies, etc. present in Canada, the United States and Mexico, it may be difficult to agree on a shared mountain vision that satisfies everyone. What is even more concerning, however, is the dearth of

dialogue taking place at the national level – let alone the continental level – that even attempts to integrate the issues facing the region's mountain ecosystems. The institutions, governments and civil society groups involved largely tend to focus on individual mountain issues, ignoring the need for holistic approaches. Policy actions are urgently needed to promote increased collaboration.

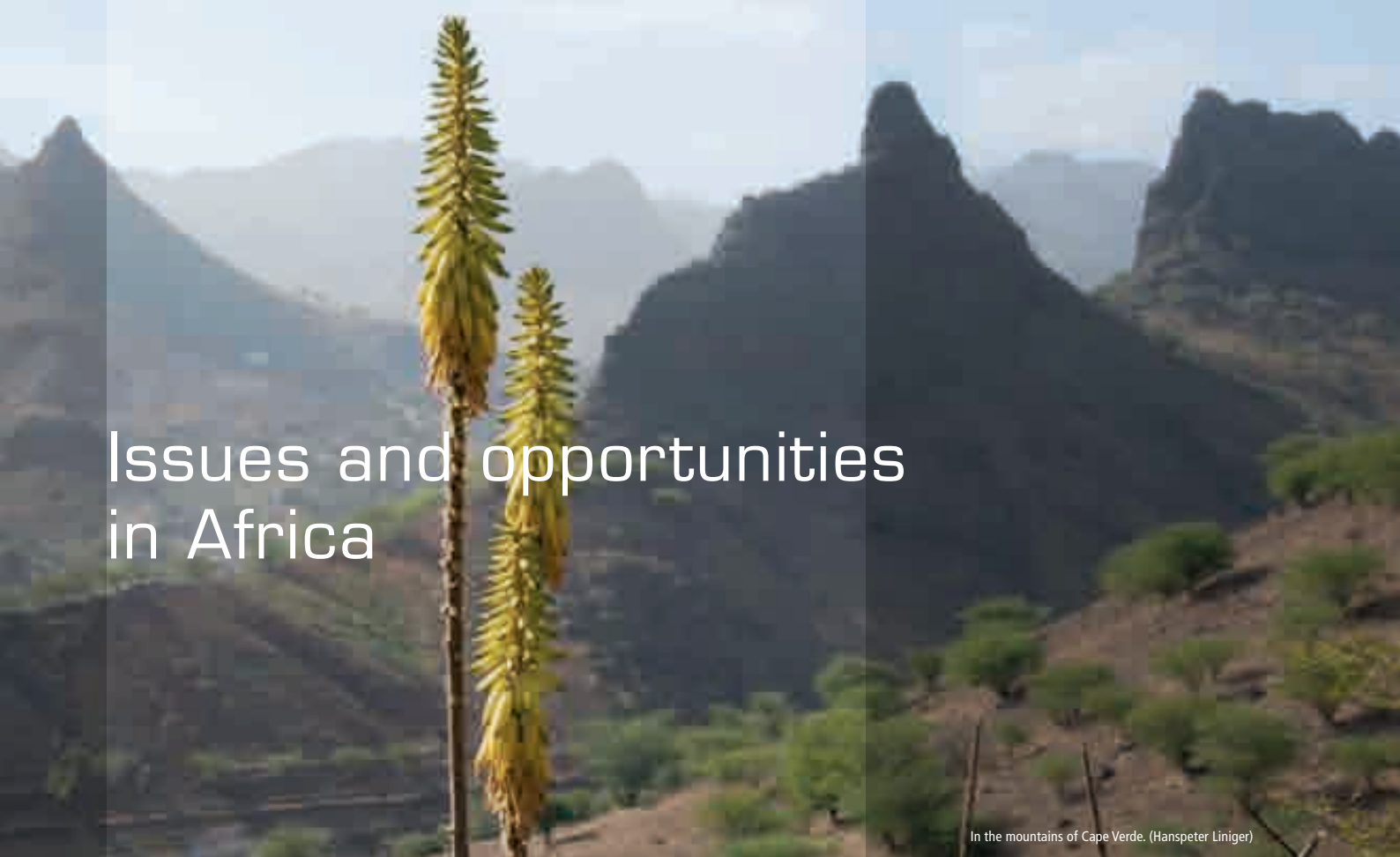
Intensify research on mountains and integrate scientific and local knowledge. More research is needed that focuses on mountains as socioecological systems. Efforts to integrate scientific knowledge with local communities' engagement and experience need to be strengthened, in order to improve mountain policy and practice in the region.

Strengthen leadership at the national level. The challenges facing North America's mountain regions are not going away – they are increasing. Lack of leadership and direction at the federal level is a major obstacle to progress in addressing these challenges. Mountains and their people need to receive more attention on the national policy agendas.

Raise awareness of mountain ecosystems' contribution to well-being in the entire region. North America's countries lack a national focus and policy on mountains that emphasizes the contributions they make to North America's environmental, economic and social well-being. This would help articulate the importance of protecting mountain ecosystems.

Develop national mountain policies. In the United States, the National Oceans Council has developed priority objectives and an implementation plan that the country will pursue in order to address some of the most pressing challenges facing the oceans, the coasts and the Great Lakes. A similar policy focus is required for mountain ecosystems. National mountain policies are needed that contain guiding principles for management decisions and actions relevant to mountain areas. They should ensure that mountains and their surrounding downstream areas remain healthy and resilient, safe and productive, understood and treasured, so as to promote the well-being, prosperity and security of present and future generations. If Canada, the United States and Mexico were to adopt such national policies, it could be the catalyst that brings stakeholders together to work towards sustainable mountain development throughout North America.

Extracted from: Wallace, R. J., DeVore, K., Lifton-Zoline, P. & Lifton-Zoline, J. 2012. *Sustainable Mountain Development in North America: From Rio 1992 to Rio 2012 and Beyond*. Telluride, CO, USA: Aspen International Mountain Foundation, The Telluride Institute. 97 pp.



Issues and opportunities in Africa

In the mountains of Cape Verde. (Hanspeter Liniger)

Why mountains in Africa matter

African mountains are highly vulnerable water towers and breadbaskets for the lowlands. Mountain ecosystem services ensure water, food and energy security, help conserve biodiversity, and support sustainable development and poverty reduction across the entire continent.

Climate change, rapid population growth and land-use change have confronted African mountain regions and their inhabitants with multiple uncertainties. Policy action is urgently needed to promote funding and investment in sustainable mountain development in Africa.

How current trends affect sustainable mountain development in Africa

Approximately half of Africa's countries have mountains higher than 2000 m. The highest mountains with peaks above 4500 m are concentrated in the northwestern, central and eastern parts of the continent (Figure 4.8). African mountains cover a surface area of around 3,000,000 km² and provide life-supporting goods and services for millions of people, including water, food and energy security at the local, national and regional levels.

African mountains are water towers. On this continent dominated by arid and semi-arid areas, water supply largely depends on rivers originating in the mountains. Low-lying arid areas in countries such as Sudan, Egypt and Namibia receive water from the mountainous sources of large rivers including the Nile, Niger, Senegal, Congo, Tana, Zambezi and Orange. Several countries in West Africa depend on water resources from the Fouta Djallon highlands. In East Africa, Mount Kenya is the only source of freshwater for more than seven million people. In Southern Africa, the Drakensberg supplies most of the water used throughout the subcontinent.

*"After climbing a great hill,
one only finds that there are
many more hills to climb."*
(Nelson Mandela, 1918–)

Hydropower is the main source of clean energy in East Africa and is also important in West and Southern Africa. Overall, the continent still depends largely on conventional sources of energy and is hence badly affected by the rising oil prices. Through hydropower, mountains can contribute significantly to energy security.

Mountains host a variety of ecosystems such as forests, grasslands, drylands, rivers and wetlands. The Fynbos Biome in South Africa is home to 6200 endemic plant species, and Mount Mulanje, Mount Rwenzori, Mount Cameroon, the Fouta Djallon and the Ethiopian highlands contain centres of high endemism as well. This biodiversity is a vital source of future food, medicine and tourism development.

African mountain terrain is used intensively. Population density in Africa's mountain regions averages over 33 persons per km² and reaches up to 500 people per km² in some areas, whereas the lowlands have less than 15 persons per km². Yet mountains directly support the lowlands; in tropical and subtropical Africa, mountains

Figure 4.8: African mountains





Large and small-scale farming on Mount Kenya, Kenya. (Urs Wiesmann)

offer more favourable environmental conditions and more abundant resources than the surrounding lowlands, which are generally much drier. Mountains thus enable higher and better-quality yields. This makes them important breadbaskets that contribute significantly to food security in the lowlands and throughout the region.

The flow of ecosystem services from mountains to lowlands is essential to promoting sustainable development and poverty reduction throughout the continent.

However, the sustainability of ecosystem services in African mountains is at great risk. Poverty and environmental degradation threaten the integrity of mountain ecosystem goods and services. This is aggravated by population growth, land-use conflicts and political insecurity. In addition, the effects of climate change are particularly noticeable in the mountains, forcing local populations to adapt to new circumstances. A lack of sufficiently enabling conditions for funding and investment in initiatives for sustainable mountain development is a major obstacle to the promotion of water, food and energy security as well as to biodiversity conservation.

Policy action for Africa's mountains

Urgent policy action is needed at the regional and subregional levels to advance the mountain agenda for Africa and create a constituency to support it in a systematic, integrated and coordinated manner. Forums like the African Ministerial Conference on the Environment (AMCEN) and regional intergovernmental organizations are best placed to endorse this process.

At the national and local levels, efforts should be directed towards mainstreaming issues of sustainable mountain development in overall development and strategic planning agendas, as well as towards recognizing mountain communities as equal partners in the policy- and decision-making process. Policy action at all levels requires strategic public–private partnerships, multisectoral planning and transboundary cooperation that takes into account key highland–lowland linkages. The following list outlines a number of recommended policy actions.



Simen Mountains, Ethiopia. (Natalie Schäfer)

Negotiate, plan and set up an African mountain hub. Community-based and high-level consultations should be initiated towards establishing a specialized platform for building knowledge and capacity, establishing standardized research methods, sharing information and promoting awareness, communication and advocacy.

Support adequate management of ecosystem services in view of climate change. Policy actions should focus on creating tools and guidelines for ecosystem services evaluation, as well as on developing ecosystem-based adaptation approaches and establishing early-warning systems (e.g. national environmental observatories).

Develop mountain-specific policies and modes of governance. Actions are needed for developing innovative mountain-specific policies as well as institutional models for regulation and governance that are tailored to the various mountain regions and specific processes of sustainable development. These actions should consider community-based models for conservation and balance the interests of highland and lowland societies.

Promote investment in value chains and value-added products and services. An enabling environment and incentives need to be created to promote investments in a green economy, for example in climate-smart agriculture, agroforestry products, renewable energy and ecotourism.

Implement market-based financing and compensation mechanisms. Market mechanisms need to be harnessed to ensure equitable sharing of the benefits of mountain ecosystem services.

Extracted from: United Nations Environment Programme (UNEP). 2012. *Why Mountains Matter for Africa: Policy Brief on Sustainable Mountain Development, Rio 2012 and Beyond*. Bern, Switzerland: UNEP, Research Network on Global Change in African Mountains (AfroMont). 2 pp.



Issues and opportunities in the Middle East and North Africa

In the mountains of Oman. (Daniel Maselli)

Why mountains in the Middle East and North Africa matter

Mountains feature prominently in the landscape, history and culture of the Middle East and North Africa. Covering 19 countries, this region is home to approximately 6 percent of the world's population and a key player in the world economy, as it holds 60 percent of the planet's oil and 45 percent of its natural gas reserves. Most mountain systems in the Middle East and North Africa are geographically disconnected (Figures 4.9 a and b). Nevertheless, they provide vital ecosystem goods and services to nearly all countries in the region. At the same time, they face multiple global and local challenges. Their development status varies greatly, as investment in mountains is directly related to national socio-economic circumstances.

Modernization has facilitated the integration of historically isolated and neglected mountain communities in the Middle East and North Africa into the wider national contexts. However, sustainable development of the region's mountains is hampered by urban expansion, climate change, desertification, political unrest, conflict and degradation due to inadequate local practices. Until now, apart from some advances in biodiversity conservation and water management, fairly little has been done to tackle these challenges. Substantial investments in sustainable mountain development have yet to be made in this region where natural capital other than oil enjoys little visibility. Improvements in livelihoods and in protection against natural disasters and economic shocks are largely attributed to oil- and gas-fuelled growth, while mountains, despite their great natural wealth and green development potential, remain marginalized in the broader economic, political and decision-making context.

"Mountains are the beginning and the end of all natural scenery."
(John Ruskin, 1819–1900)



Village and orchards, Morocco. (Daniel Maselli)

How current trends affect sustainable mountain development in the Middle East and North Africa

Mountain aquifers, rainwater harvesting systems on mountain slopes and well-constructed retention dams in the foothills support local water needs in many Middle Eastern and North African drylands. This is a vital service to the region, where water scarcity, accentuated by rapid population growth, costs countries between 0.5 and 2.5 percent of their gross domestic product each year. The region's lowland areas benefit from its mountain resources. In Iran and Morocco, mountain water is used to produce hydropower for downstream consumption. Throughout the region, rivers and floods carry sediments from the mountains downstream, contributing soil and organic matter to lower-lying farmlands and thereby increasing their fertility.

The mountains of the Middle East and North Africa host much of the region's great biodiversity and endemic plants and animals. They are repositories of medicinal plants, spices and other wild foods that are highly valued by the local people, and they support many forests and woodlands. Mountains also offer farmland to support local sustenance and, in some cases, grow produce for export, along with rangelands sustaining traditional livestock systems. With an impressive number of tribal people and important pilgrimage sites, such as Mount Sinai in Egypt, mountains hold extraordinary cultural and sacred significance in the region. This, along with breathtaking landscapes and views, attracts tourists and provides opportunities for recreation. Tourism accounts for up to 9 percent of the gross domestic product of Middle Eastern and North African countries. It continues to gain economic importance and has even expanded to countries like Saudi Arabia and Oman, that merely a decade ago were still closed to tourists.

In the Middle East and North Africa, progress has been made on biodiversity conservation and watershed management through the implementation of protected areas and two biosphere reserves, the appointment of specialized ministries for

water resource management, and government-encouraged revitalization of traditional water harvesting systems in some areas. However, the substantial differences between national economies translate into various degrees of development, public service provision, livelihood support and poverty eradication in mountain areas. The contrasts are evident. The oil-fuelled economic boom has enabled important investments in services and infrastructure in the mountains of some Middle Eastern countries, including building “the world’s most advanced road” in the United Arab Emirates, whereas the overpopulated Atlas Mountains in Morocco and the southern highlands in Yemen have remained pockets of poverty.

Demographic growth, rapid urbanization and even booming economies have negatively affected mountain areas and populations in the Middle East and North Africa, raising concerns about the sustainability of both traditional and new economic activities. Tourism, for example, provides income to mountain dwellers from the sale of handicrafts, carpets and other local products, but puts additional stress on water resources, increases environmental degradation and in some instances causes cultural perturbations by violating local customs. Growing populations and the growing demand for meat and dairy products from free-ranging mountain livestock in the thriving markets of some of the region’s countries have led to overgrazing and even desertification. Along with droughts and land tenure conflicts, this is seriously affecting poor mountain communities who depend on livestock for their livelihoods. Simultaneously, in the region’s rich oil nations, overgrazing occurs because people keep large herds – not to satisfy local needs, but as a symbol of wealth and prestige, while herders consume imported meat. Another phenomenon associated with the marked economic differences between countries is the outmigration from areas with high unemployment, including mountain areas. In the Maghreb, for example, as much as one-third of the adult male population leave their home area in search of foreign labour opportunities for the better part of the year.

Mountains are often the home of ethnic minorities with very little influence in politics and governance. Accordingly, mountains have remained marginalized in most Middle Eastern and North African countries. The coexistence of multiple tribes in these areas has repeatedly led to intertribal conflicts that hamper development.

Figure 4.9a: Major mountain ranges in North Africa



Most conflicts are related to water rights, rangeland use, competition for marketable ecosystem services and uneven sharing of subsidies. Some marginalized mountain areas have become places of illegal drug production and trafficking, aggravating national and international tensions. More recently, countries in the Middle East and North Africa have experienced political unrest, with protests demanding change and reforms in governance, ranging from partially peaceful (Oman) to extremely violent (Libya, Syria). This political climate is likely to have a negative impact on sustainable development initiatives, including those in the mountains.

A high vulnerability to climate change adds to the region's environmental and social fragility. Climate change impacts predicted for the Middle East and North Africa are far-reaching and include an increase by 2.2 to 5.1 °C of the mean annual temperature in the southern and eastern Mediterranean; a decrease in river flows; long-term salinization of inland aquifers; the loss of vast amounts of farmland suitable for rainfed agriculture; a decrease in the yields of major food crops; extinction of countless wild species (up to 60 percent of all plants in the Mediterranean basin by 2080); shortened grazing periods due to prolonged dry seasons; and longer and more severe droughts. Although evidence of the effects of global warming on Middle Eastern and North African mountains is poorly documented, the extensive droughts experienced in Syria, Iraq, Lebanon, Palestine and Israel over the past years highlight the fragility of rural areas. Local and national governments proved unable to cope with the situation of insufficient rainfall to sustain agricultural production. In eastern Syria, for example, the prolonged drought affected an estimated 1.3 million people, accelerated migration to urban areas and increased levels of extreme poverty. Considering that among the world's regions,

Figure 4.9b: Major mountain ranges in the Middle East





Toujane, a village in the Dahar Mountains, Tunisia. (Ursula Gämperli)

the Middle East and North Africa has the fewest renewable water resources, the least arable land per person and the highest proportion of imported food, devising climate change adaptation and coping strategies is imperative.

Addressing social inequity, environmental degradation and climate change and fostering sustainable development in the mountains of the Middle East and North Africa requires strong political commitment and action. Governments must gain a better understanding of the supply of, and demand for, ecosystem services in order to shift spending priorities, support green economy initiatives and build capacity through training and education. Establishing a forum or mountain stakeholder network for Middle Eastern and North African countries to share experiences and lessons learned could be a first effective step to this end.

Policy action for the mountains of the Middle East and North Africa

The promotion and implementation of sustainable mountain development in the Middle East and North Africa requires commitment and action at the policy level. The following list outlines recommended policy actions.

Protect natural resources and foster their sustainable use. Along with ensuring adequate protection of resources, it is important to help devise strategies for their sustainable use. A healthy natural resource base will help improve the socio-economic well-being of mountain communities.

Involve mountain communities in decision-making and give them a political voice. Harnessing the commitment and knowledge of those who are directly affected is essential in achieving sustainable resource use, environmental protection and food security.

Promote fair access to resources and equitable sharing of benefits. Policy actions should support mountain communities in gaining fair access to resources, and help share benefits from the use of mountain resources equitably.

Strengthen and develop national and regional institutions and establish links with global institutions. Strong institutions that cooperate and coordinate their actions are key in addressing highland–lowland interactions. Policy actions should focus on transboundary cooperation, capacity building, knowledge generation and dissemination, technical expertise and innovation for sustainable mountain development.

Strengthen mountains within the three Rio conventions. Policy actions should aim at achieving recognition of the vulnerability of mountain ecosystems within the three Rio conventions. Suggestions for enhancements and recommendations regarding adequate implementation strategies should be based on a review of how mountain issues were handled within the three Rio conventions, combined with an analysis of achievements and the reasons for success and failure of the related action plans.

Promote the transition from the brown economy to a green economy. A greener economy can support sustainable development in the mountains of the Middle East and North Africa in many ways.

Identify and address specific issues affecting mountain communities. Middle Eastern and North African mountain communities face a number of problems that need to be addressed at the international level, such as illegal drug production, terrorism and political disputes. Policy actions are needed to establish international intervention procedures.

Mobilize financial means for sustainable and equitable mountain development. Policy actions are needed to create enabling conditions and incentivize investments in sustainable mountain development. National budgets need to include appropriate funding to help enhance well-being and reduce disparities. Best use must be made of new and existing funding mechanisms to promote sustainable mountain development in the Middle East and North Africa. Innovative approaches and initiatives need to be launched, including public-private partnerships.

Extracted from: Victor, R. 2012. *Sustainable Mountain Development in the Middle East and North Africa: From Rio 1992 to Rio 2012 and Beyond*. Al Khoudh, Sultanate of Oman: Sultan Qaboos University. 108 pp.



Issues and opportunities in the Hindu Kush Himalayas

Mount Everest, Nepal. (Alex Treadway, courtesy ICIMOD)

Why mountains in the Hindu Kush Himalayan region matter

The Hindu Kush Himalayan region extends across South and Southeast Asia and encompasses mountain ranges in Afghanistan, Pakistan, China, India, Nepal, Bhutan, Bangladesh and Myanmar (Figure 4.10). These mountains are home to 210 million people and the source of ten major river systems with basins that cover almost 9 million km². The Hindu Kush Himalayas have the largest area covered by glaciers and permafrost outside the polar regions; for this reason, they are sometimes referred to as the Third Pole and Asia's water tower. The region plays an important role in global atmospheric circulation, as it influences the monsoon and the westerly weather systems. Mountains in the Hindu Kush Himalayan region support a unique mosaic of biota and ecoregions, provide vital ecosystem goods and services to more than 1.4 billion people, and recharge and nurture some of the richest ecosystems and farmlands in the world.

Despite its natural wealth, the Hindu Kush Himalayan region is home to more than 40 percent of the world's poor people and faces extreme vulnerability and risks due to deforestation, desertification, socio-economic transformation, climate change and other forms of global change. Progressive warming at higher altitudes has resulted in increased snow and glacial melt and in more frequent and devastating floods and droughts, which exacerbate poverty and food insecurity. The harsh terrain, along with a lack of enabling institutional frameworks, policy constraints, weak implementation mechanisms and insufficient technical capacity, poses serious challenges to sustainable development in this important mountain system.

"It is not the mountain we conquer but ourselves."

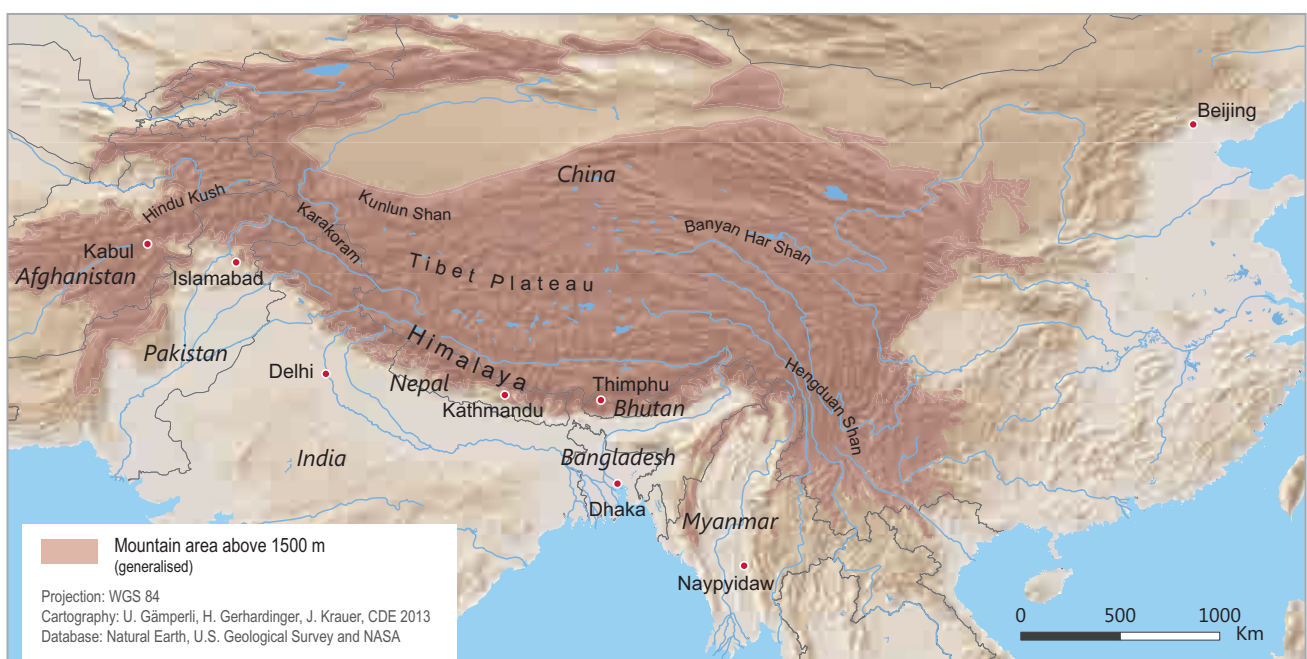
(Sir Edmund Hillary, 1919–2008)

How current trends affect sustainable mountain development in the Hindu Kush Himalayas

The mountains of the Hindu Kush Himalayan region offer a wealth of natural resources that are vital for supporting the livelihoods of more than 1.4 billion people both in the mountains and in the surrounding lowlands. The region is rich in animal and plant species. It contains 28 percent of the world's protected areas, as well as 4 global biodiversity hotspots, 330 important bird areas and 60 global ecoregions. The ten major river systems that originate in the Hindu Kush Himalayas, along with the region's numerous other lakes and aquifers, maintain water supply, food production and energy generation in the region and support the two fast-growing economies of India and China. Estimated at US\$ 150–170 billion, the services that Hindu Kush Himalayan ecosystems provide each year also include water purification and regulation; soil and water conservation; climate change mitigation; provision of food, fodder, forage, timber and non-timber forest products; as well as sacred sites and spaces for recreation. Healthy ecosystems in the region also ensure slope stability, thus protecting people and infrastructure against flash floods, landslides and avalanches.

However, these invaluable ecosystem services are increasingly at risk. Rapid population growth, deforestation and climate change have had pronounced negative effects on mountain ecosystems. Progressive warming at higher altitudes is three to five times the global average and has led to rapid glacial retreat, shrinking lakes, diminishing river flows and reduced water availability in the river basins to meet agricultural and domestic needs. Warming processes have begun to degrade permafrost, soils, forests and pastures and are causing more frequent extreme weather events. The rising temperatures and the related loss of ice and snow cover are expected to have further and more serious cascading effects with potentially catastrophic consequences, as even monsoon patterns might be altered. Changes in the hydrological cycle might significantly modify precipitation, river runoff and nutrient cycles along the river basins, with adverse impacts on ecosystems, farmland and rangeland productivity, freshwater supplies, hydropower production and on the millions of people whose livelihoods depend on them. Predicted glacial lake outburst floods, along with more frequent and intense floods and droughts,

Figure 4.10: Mountains of the Hindu Kush Himalayan region





Chess champs of Thamo, Nepal. (Rodney Garrard)

will pose a serious threat to lives, infrastructure and economic activities, and will adversely affect food security and human health.

Close to 50 percent of all mountain people in the Hindu Kush Himalayas earn their livelihoods from farming and animal husbandry. The region's harsh climatic conditions, poor market access and the small size of farms have forced most of them to rely on subsistence farming. This, along with a heavy dependence on fuelwood for heating and cooking, has increased pressure on environmental resources and contributed to high deforestation rates. Changes in the land cover of key river basins are alarming: the Indus and Ganges basins have lost 90 and 85 percent of their original forest cover, respectively. Traditional methods of dealing with water scarcity are vanishing, and increasing temperature and rainfall variability has a particularly pronounced impact on mountain farms due to their relatively small size. All these processes of change have directly affected mountain communities' sources of income.

Over 40 percent of the world's poor live in the Hindu Kush Himalayan region. Within its mountains, geographic isolation, sociocultural marginalization, low investment in infrastructure and public services, as well as limited access to markets, technology, information and institutions are associated with poverty and constrain populations from sharing in the economic benefits of regional growth. Limited employment opportunities and economic insecurity in the mountains have triggered outmigration. Many men move away to find work, leaving behind mostly women, children, elderly people and economically less active members of society with fairly low entrepreneurial capabilities. Migration is increasingly becoming a livelihood strategy, not only to raise family income but also to adapt to ongoing changes. Close to 15 percent or 30 million of Asia's economic migrants come from countries in the Hindu Kush Himalayan region, which receives the highest inflow of remittances of all regions in the world – close to US\$ 70 billion in 2007. Unfortunately, the diaspora has hardly contributed to sustainable mountain development, as home economies have not succeeded in encouraging migrants to re-



Namche Bazar, Nepal. (Rodney Garrard)

turn and invest in productive mountain areas. In fact, most skilled migrants never return to their countries of origin.

Tourism, particularly ecotourism, is another important source of employment and economic revenue in the Hindu Kush Himalayas. Mount Everest, the world's highest mountain, is one of the most popular tourist attractions worldwide, and trekking in the Himalayan valleys and across passes is a popular and steadily growing tourist activity. Tourism accounts for about 4 and 9 percent of the gross domestic product in Nepal and India, respectively. However, some impacts of tourism are increasingly raising concern. In many countries of the Hindu Kush Himalayan region, tourist towns and trekking routes have suffered from this resource-intensive industry, which has led to overconstruction of resorts and other facilities. Moreover, unregulated access to fragile mountain landscapes has had the unintended effect of rendering the people who live there invisible. Many of them have ended up working as menials or porters. Their share in the benefits of tourism is negligible, as revenue largely flows to actors outside the region.

In the past 20 years, the Hindu Kush Himalayan region has undergone a broad economic and sociopolitical transformation. China has consolidated its position as an economic driver, while India, Pakistan and Bangladesh have the potential to become one. South Asian countries and China have made significant progress in integrating with the global economy, while integration within the region – vital for sustainable economic growth – has remained limited, affecting the pace of development in landlocked countries such as Nepal and Bhutan. Unresolved political issues, a lack of communication and transportation links, as well as restrictive trade policies have proven major barriers to transboundary regional economic cooperation.

The entire region has witnessed grassroots social movements, some of them violent, emerging in opposition to marginalization within national and regional governance. In parallel, important democratic changes have swept the Hindu Kush



Herder near Namtso Lake, Tibetan Plateau. (Eva Spehn)

Himalayas: absolute monarchies have been abolished and dictatorship has melted down. There has been a general move towards greater devolution and decentralization of power to local governments, helping mountain people attain their aspirations for self-governance to some extent. Nepal is establishing new and smaller federal units that are expected to be more effective in meeting local development needs. India's Uttarakhand has become an autonomous hill state and has begun to focus on developing mountain-specific policies and programmes. Pakistan has created a mountain province, Gilgit-Baltistan. These changes have enabled self-governance and institutional reforms in areas with unique landscapes and a distinct biocultural heritage. Initiatives for collective natural resource management have prospered in the region as well, including Nepal's community forestry programme – the largest and longest participatory green initiative, involving 40 percent of the country's population in managing 28 percent of its forest area.

Today there are multiple opportunities to improve livelihoods and promote sustainable development in the mountains of the Hindu Kush Himalayan region. They include improved local access to, as well as ownership and management of, natural resources; the expansion of information and communication technologies well into remote mountain areas, connecting them to the mainstream of development; the use of emerging carbon payments through the Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism, which promises to provide incentives and benefits to communities; as well as decentralization processes and new efforts to enable and empower local institutions in mountains. However, sustainable mountain development would also benefit from increased investment by national and global agencies in creating green jobs through green infrastructure projects. Furthermore, institutional reforms and enabling policies, supported by regional cooperation as well as knowledge and experience sharing, could create incentives for integrated agriculture and natural resource management and help promote community-based enterprise development. A development approach that incorporates mountain people's traditional knowledge in the context of a green economy – rather than following a global agenda agreed upon without their participation – and the effective integration of communities in local administration can contribute to overcoming persistent challenges faced in the region, such as poverty, inaccessibility and inequity.

Policy action for the Hindu Kush Himalayas

Efforts towards sustainable mountain development in the Hindu Kush Himalayas should not concentrate exclusively on mountains; they should be designed to benefit entire river basins. The focus must be on actions that ensure the continued supply of mountain ecosystem goods and services that are critical to promoting a green economy in both upstream and downstream communities. Natural resource scarcity and inequitable distribution of benefits are emerging as major drivers of social conflicts in the Hindu Kush Himalayas. Adopting a mountain perspective in addressing national and regional issues is thus more than a matter of choice. It is becoming imperative that all countries pursue green development pathways and policies of good governance. The following list outlines recommended policy actions.

Invest in building green infrastructure. Mountain countries must invest in green projects and reform policies to provide incentives to sectors that offer opportunities for sustainable green growth, such as agriculture, natural resource management and local enterprise development. They must promote the use of sound technologies in the highlands.

Enhance environmental governance to drive a green economy. A green economy in the region has to rely on a strong natural resource base – water, biodiversity, forests and clean energy sources. These resources must be managed as public goods, in line with the principles of good governance and social equity and involving local communities in accounting for the full value of ecosystem goods and services. This includes reorganizing marginal mountain communities' role in environmental stewardship.

Reform policies and strengthen implementation mechanisms. Policies that provide incentives to use natural resources sustainably, allocate environmental costs and benefits equitably and promote equity and justice are vital to sustainable mountain development in the Hindu Kush Himalayas.


Promote public–private–civil society partnerships. The private sector can play an important role in the development of the Hindu Kush Himalayan region. Incentives should be provided for green initiatives and other innovative financing ventures that follow principles of corporate social responsibility.

Consolidate diverse funding mechanisms for integrated development in mountains. Financing mechanisms in the climate change, biodiversity, Millennium Development Goal and Sustainable Development Goal sectors must be consolidated to enable adequate funding of conservation and adaptation efforts and meet mountain countries' sustainable development needs.

Strengthen institutions. National and regional institutions must be strengthened to facilitate upstream–downstream economic and knowledge exchange, trans-boundary cooperation and capacity building.

Promote regional cooperation. Regional cooperation is key to developing a green economy and good environmental governance, as well as to enhancing access to markets, finance and technology transfer.

Extracted from: Karki, M., Sharma, S., Mahat, T. J., Tuladhar, A. & Aksha, S. 2012. *Sustainable Mountain Development in the Hindu Kush–Himalaya: From Rio 1992 to Rio 2012 and Beyond*. Kathmandu, Nepal: International Centre for Integrated Mountain Development (ICIMOD). 73 pp.



Issues and opportunities in Central Asia

Unplanned settlement along a major transport route in the Central Asian mountains. (Daniel Maselli)

Why mountains in Central Asia matter

Central Asia's mountains extend across Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan (Figure 4.11) and provide an astounding array of essential ecosystem goods and services – not only to mountain dwellers but also to people in the lowlands and around the globe. The region's over 20 mountain ecosystems maintain global natural and agricultural biodiversity, offer forest products and land for food production, and play a pivotal role in water storage and regulation, climate and natural hazard mitigation and watershed protection. In addition, natural mountain environments provide the region with important areas for leisure and recreational activities.

Once barriers to trade, the mountains of Central Asia are now becoming important commercial hubs. Tourism, mining and trade have been gathering momentum, and the supporting infrastructure has developed accordingly. A mix of traditional skills and modern practices is contributing to Central Asia's economic and social transformation brought on by the former Soviet republics' independence in the early 1990s. However, the region faces a number of shared challenges, such as climate change and the need to ensure food and regional security, protect biodiversity and reduce disaster risk. An effective response to these challenges urgently requires collaboration between communities, within nations and across national boundaries.

How current trends affect sustainable mountain development in Central Asia

Central Asia's mountains modulate the climate across wide areas and are important reservoirs for carbon storage, but global warming is melting away mountain glaciers and snow reserves and at the same time increasing the water requirements of basic agricultural crops. Water shortages in downstream and lowland areas are

*"Who hasn't been here,
hasn't taken the risk,
They haven't put themselves
to the test.
If even you've plucked stars
right from the sky:
Down there you won't see,
try as you might,
In all your long
and happy life,
One-tenth of the beauty
and wonders you see
from on high."
(Vladimir Vysotsky, 1938–1980)*

challenging governments and, in some cases, international relations. Overall, Tajikistan and Kyrgyzstan, the region's most mountainous and least economically developed countries, hold 40 and 30 percent, respectively, of the water resources that supply the five countries of Central Asia as well as areas in China and Russia. Uzbekistan and Turkmenistan, by contrast, receive 90 percent of their water resources from mountains outside their national borders, and with their vast areas of irrigated agriculture, they are highly vulnerable to water shortages. Lowland agriculture requires water in the summer and autumn, while the mountain countries need it for power generation primarily in winter. Finding a balance between hydropower generation, including by large-scale hydropower plants, and water provision for large-scale irrigated agriculture is difficult and politically sensitive. Tensions over water and energy may escalate as the demand for energy and food continues to grow.

Central Asia has experienced a profound sociopolitical and economic transformation following the disintegration of the Soviet Union. All former Soviet republics declared their national independence and entered a period of upheaval during their transition to democracy and a market economy. Pronounced differences in the speed of development emerged between the region's nations. The energy-rich and industrialized countries – Kazakhstan, Uzbekistan and Turkmenistan – enjoyed large capital inflows in energy and industrial projects and invested in their infrastructure, especially in their capital cities. In Tajikistan and Kyrgyzstan, by contrast, the withdrawal of Soviet support had drastic consequences, particularly in their remote rural mountain communities. Their economies collapsed and jobs became rare, triggering an exodus of skilled workers and unleashing a downward spiral. Both countries' gross national product dropped by almost 50 percent in just five years, and the new states were unable to maintain public spending priorities. Many mountain communities suffered undernourishment during this period of

Figure 4.11: Main mountain regions of Central Asia

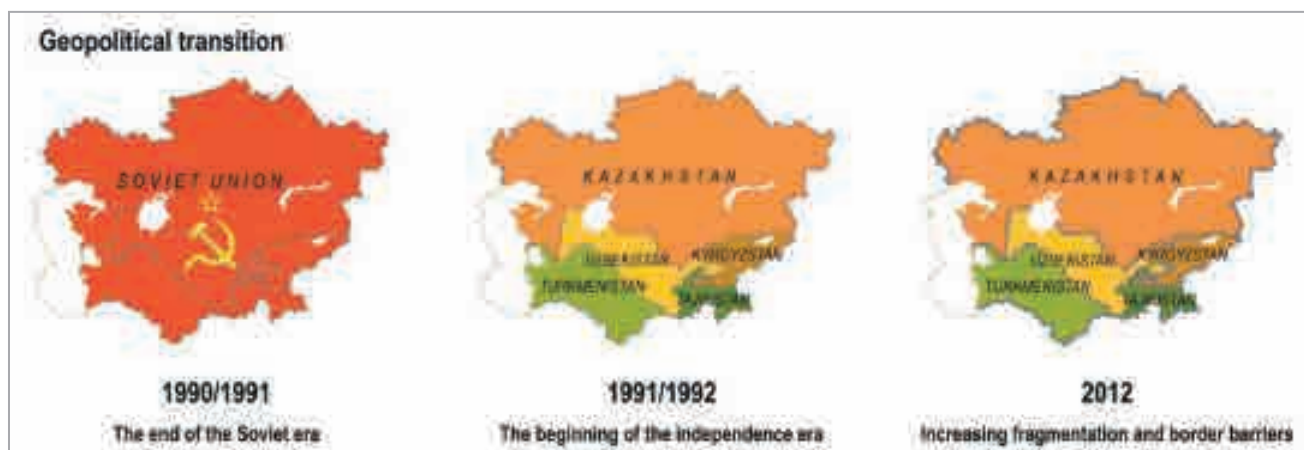


disruption. In the past 5 to 10 years a new system of self-management has taken root, and mountain farmers have become more self-reliant. The Kyrgyz and Tajik economies have recovered and once again reached their 1991/92 levels, and poverty has been almost halved. Nevertheless, the two countries remain the poorest in the region. Their total external debt has increased, and with remittances accounting for 30 to 40 percent of their gross domestic product, their national economies are vulnerable to changes in the economic and labour conditions of the countries receiving migrants. As neither Kyrgyzstan nor Tajikistan is food-sufficient, rising international food and fuel prices add to their social and economic vulnerability. Moreover, migration has changed the social fabric of traditional mountain communities, augmenting the workload of women and village elders.

The creation of national borders following the independence of the Central Asian states (Figure 4.12) affected trade and had a particularly adverse impact on nomadic mountain populations who had traditionally moved through the region's mountains and plains. The borders altered the ownership status of previously shared pastures, forests and watersheds and created mountain enclaves – islands of one country inside another – further increasing the isolation of already remote areas. Moreover, demarcated borders and border crossings require infrastructure and burden national economies. While the wealthier lowland countries have been able to maintain a reasonable level of border security, limited financial and military resources have hindered Tajikistan from preventing the intrusion of armed troops and drug trafficking across the Tajik–Afghan border.

The abrupt end of Soviet rule also affected the natural environment in the mountain areas of Central Asia. On the brink of famine and confronted with permanent fuel shortages, people in the Kyrgyz and Tajik mountains overexploited and decimated their wild fauna and flora, with direct negative implications for biodiversity and the natural vegetation cover in their region. Other environmental issues of concern in Central Asia's mountains are abandoned mines, hazardous industrial waste sites and uranium mine tailings – mostly legacies from the Soviet era. They have remained unremediated and seriously endanger the health and security of local inhabitants and populations nearby. Nevertheless, the region's mountains are an important source of minerals (Figure 4.13). Despite these environmental drawbacks, Central Asian countries are substantially expanding their protected areas and creating special reserves for watershed protection, forestry or regulated hunting; in addition, individual planting initiatives have been launched. All of this is done with a view to both environmental and economic benefits. However, the region's mountain ecosystem goods and services remain threatened by growing population numbers, land degradation and climate change.

Figure 4.12: Geopolitical changes in Central Asia



Like other regions, Central Asia has been affected by progressive global warming. An increase of up to 1.2 °C in surface temperature has been recorded in the mountains of Kyrgyzstan and Tajikistan over the past 70 years. This trend will continue: under likely climate change scenarios for the region, average temperatures are predicted to increase by 1 to 3 °C by 2050. Climate change scenarios also predict reduced precipitation in the southern parts of the region. Mountain dwellers as well as hikers have already reported visible changes in frequently visited glaciers of the region. For example, it has been estimated that between 15 and 35 percent of glaciers in the Tien Shan and Pamir mountains disappeared over the past 60 years; and currently up to 1 percent of the region's glacier cover is lost each year. In addition, the area of seasonal snow cover in the Tien Shan has decreased by as much as 15 percent over the past 20 years, with rain replacing summer snow more and more often even at high altitudes.

Given that snowmelt and rainfall are the two main sources of water runoff from the mountains of Central Asia, climate change effects are expected to be the main determinants of water availability in the region. Scenarios of strong climate warming and low precipitation predict a drop in the main rivers' water resources by 15 to 40 percent, with direct impacts on freshwater supply and irrigated agriculture. Furthermore, expected droughts and crop failures will force inhabitants of rainfed mountain areas and pastures to migrate to cities and irrigated oases. As mountain countries, Kyrgyzstan and Tajikistan will probably have enough water for their own needs but at some point might no longer be able to fulfil their role as regional water towers. Competition for water for agricultural production and power generation in the region is likely to increase as river flows decline.

Besides affecting water availability, climate change has increased the risk of floods, mudflows and landslides in the region. There has been a series of glacial lake outburst floods in the mountains of Tajikistan, Uzbekistan, Kyrgyzstan and Kazakhstan.



Figure 4.13: Key mineral resources in Central Asia



Horses grazing on a summer pasture (*jailoo*) in Kyrgyzstan. (Daniel Maselli)

Glacier melt creates glacial lakes every summer. Occasionally their natural dams burst, releasing enormous amounts of water in destructive flash floods, with serious impacts on life and property. Currently the Central Asian mountains contain almost 1000 glacial lakes, and dozens of new and potentially risky glacial lakes appear every year in the mountainous areas near the cities of Almaty, Bishkek and Tashkent, as well as other densely populated areas. In Tajikistan and Kyrgyzstan, average annual economic losses from natural disasters already reach 1.0 to 1.5 percent of the gross domestic product, and are expected to increase to 5 percent of the gross domestic product in the future. Pest attacks, biodiversity alterations and a substantial increase in forest fires are other effects of climate change that have already been observed and have raised concern with regard to the future.

National strategies, programmes and action plans on biodiversity, land management, climate change, natural disasters and the environment all mention the role of mountain regions. Often, however, they lack adequate and realistic financial provisions. They underestimate both implementation capacities at the local level and the transboundary importance of mountain ecosystems and their services. Sustainable mountain development in Central Asia would clearly benefit from more specific actions, sufficient resourcing for these actions, and synergies with development projects in tourism, trade and commerce, road development and agriculture. New funding opportunities are emerging or expected to emerge in the context of climate change and renewable energy, support for watershed protection, biodiversity benefit sharing and payment for ecosystem services.

Policy action for Central Asia's mountains

While the world's mountain regions have much in common, their sustainable development is specific to each region and even to different sites within a region. For a more sustainable future of mountain environments and populations in Central Asia, experts recommend the exploration of two ideas:

- The creation of a mountain countries group under the auspices of the United Nations
- The exchange of external debt for an equivalent investment in sustainable development

Linking strategies for mountain development with broader agreements on trade, economic development, conflict resolution and resource management may enhance these efforts. International organizations can build on subregional exchange of experience by providing assistance at the community level, and sub-national governments can use their power to determine their communities' future. Recommended policy actions to address major aspects of sustainable development are outlined below.

Address climate change by focusing on the links between mountains and the surrounding lowlands. Lowland countries who are affected by climate change in mountains outside their national borders are well advised to account for these foreign mountain ecosystems in their planning. Mountain regions have a vast potential for carbon storage through afforestation projects, and sustainable land-use practices will benefit the entire region. Mountain regions have the opportunity to build water storage facilities that can release water to downstream regions in drought years.

Invest in efficient water use, promote hydropower and introduce equitable compensation of mountain areas for the use of their resources and services by downstream areas. Investing in more efficient water use is cost-effective and necessary to avoid conflicts. Small-scale water management solutions are worth promoting. Principles for pricing resources and services provided by mountain areas to downstream regions should be established, tested and introduced into practice. The mountain countries' hydropower potential provides an opportunity for combined progress towards the goals of energy security, climate resilience and economic development.

Further enhance biodiversity conservation. The expansion of existing protected areas provides a basis for further biodiversity conservation, and new pasture regulations that combine a scientific approach with economic tools and community participation are paving the way for the adoption of sustainable approaches to livestock herding.

Promote community-based tourism, responsible mining and transport. The Central Asian governments can broaden opportunities for community-based tourism. In the mining sector, governments need to promote responsible mining and ensure that local concerns are voiced and respected. The mountain regions of Central Asia are strategically positioned to host rail and road links in the heart of Eurasia that would benefit their economies and raise their regional importance.

Strengthen education for sustainable development, preserve cultural diversity and promote institutional cooperation. Governments and other active players should encourage the trend of mixing traditional skills and modern practices. Central Asian universities are now specializing in issues of mountain development. Higher education institutions have the opportunity to focus on preparing the next generation of managers in tourism, natural resource management (forestry, agroforestry, non-timber forest products, wildlife), mining and infrastructure development. An integrated approach to sustainable mountain development can guide regional cooperation among government institutions and non-governmental organizations.

Extracted from: Hughes, G., ed. 2012. *Sustainable Mountain Development in Central Asia: From Rio 1992 to Rio 2012 and Beyond*. Bishkek, Kyrgyzstan and Geneva, Switzerland: University of Central Asia (UCA), Zoi Environment Network. 148 pp.

A photograph of the Chocolate Mountains in the Philippines, showing several rounded, grass-covered hills under a hazy sky. The hills are densely covered in green grass, giving them a conical appearance. The foreground shows more vegetation and a dirt path.

Issues and opportunities in Southeast Asia and the Pacific

Chocolate mountains, Philippines. (Hanspeter Liniger)

Why mountains in Southeast Asia and the Pacific matter

Mountains in the region of Southeast Asia and the Pacific extend across eleven countries both in Mainland Asia and on the islands and archipelagos of the Pacific Ocean (Figure 4.14). This region, rich in history and culture, is home to nearly 600 million people and hosts one of the world's largest and most severely threatened biodiversity and gene pools. Many of the region's indigenous peoples who inhabit the highlands have developed home-grown and time-tested knowledge and skills to protect and conserve their tropical mountain ecosystems. However, most of these people live in poverty and suffer socio-economic marginalization and political neglect.

Climate change, globalization, increased mining activities, land degradation, rural-to-urban economic shifts, demographic growth and poverty challenge sustainable mountain development in Southeast Asia and the Pacific. The region's mountains provide a wide range of vital goods and services, but in terms of policies they have been ignored entirely or subsumed in forest and other resource-specific national policies and programmes. As a consequence, mountain resources have been expropriated, with few benefits going to the mountain peoples. Global change and growing regional food, water and energy insecurity call for immediate policy reforms and action to protect social and ecological systems in the mountains of Southeast Asia and the Pacific, promote green growth and strengthen multi-stakeholder engagement and transnational cooperation in sustainable natural resource management.

"The secret of the mountains is that the mountains simply exist, as I do myself: the mountains exist simply, which I do not. The mountains have no 'meaning', they are meaning; the mountains are." (Peter Matthiessen, *The Snow Leopard*, 1978)

How current trends affect sustainable mountain development in Southeast Asia and the Pacific

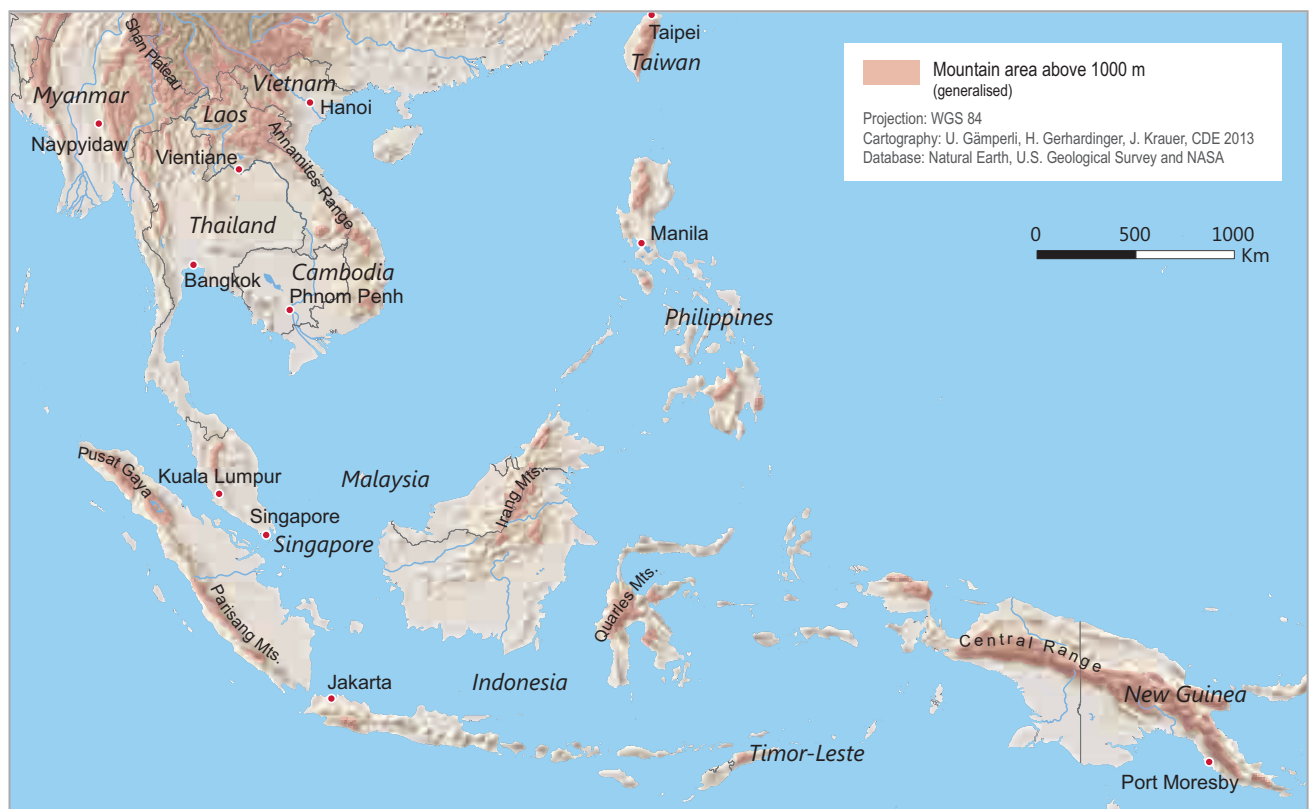
Ecosystem goods and services provided by mountains in Southeast Asia and the Pacific include the regulation of natural systems, carbon storage, forests, biodiversity, water, minerals, energy and areas of recreation and tourism that are vital to the region's sustainable development and economic growth. Unlike many goods and

services produced downstream, mountain products are strongly integrated with the topography, and coexist with other mutually supportive resources. Downstream populations share in the benefits that mountains provide, but many are not clearly aware of how much mountains contribute to the region's overall well-being.

Indigenous peoples who call the mountains of Southeast Asia and the Pacific their home account for almost 20 percent of the global indigenous population. They are the custodians of a vast diversity of cultures, languages and traditional knowledge, but are usually marginalized, poor and underserved by their respective states. The vulnerability of the region's traditional mountain dwellers has increased considerably over the past twenty years as a result of population growth, economic pressures and more frequent extreme weather events. Poverty in rural Southeast Asia and the Pacific is double that of the region's urban areas, and this wide rural-urban economic and development gap has caused young and unmarried women to increasingly adopt labour migration as a livelihood strategy. This feminization of migration patterns has been encouraged by migrants' home countries, who face great pressure to increase their foreign revenues. This development has deep repercussions on the social fabric of traditional communities. The lack of guarantees and low state interest in migrants' welfare are a major concern. While facing outmigration, mountain areas rich in resources have attracted lowland settlers and extractive companies who exploit land, timber, minerals and water resources without giving local communities their due share of benefits or caring about environmental damage.

Climate change has already affected crop productivity in the mountains of Southeast Asia and the Pacific, thus reducing the food security of large agrarian mountain populations. Water stress, shifts in cropping practices and the impacts of more frequent floods, droughts and landslides have exacerbated the fragility of the natural resource base. Climate scenarios for the region indicate that the impacts of climate change are likely to worsen and threaten the water and energy supply for millions of people. In this situation, planning and implementing adaptation strate-

Figure 4.14: Mountains of Southeast Asia and the Pacific





Rubber plantations, Lao PDR. (Kaspar Hurni)

gies is imperative. Beyond climate change, mining and the expansion of biofuel feedstock plantations are considered the greatest threats to mountain communities in the region, as these commercial activities encroach on ancestral domains, displace indigenous tribes, endanger forest ecosystems and bring no significant economic profits to local communities. Mining has increased over the last decade in the mineral-rich states of Cambodia, Indonesia and the Philippines, in many cases without proper permits, let alone control of practices. By contrast, indigenous communities are still required to go through a long and difficult administrative process to obtain land titles or permits for gathering non-timber forest products. This has direct negative effects on mountain livelihoods. At the same time competition for mountain products has increased, leading to the paradoxical situation where market security for local products is threatened by the introduction of goods from other areas. With mountain people increasingly depending on imported products, many traditional systems and processes, such as barter trade, are gradually disappearing.

Southeast Asia and the Pacific has experienced important socio-economic and political changes during the past two decades. With an average annual economic growth of 5 percent during the past 25 years, the region has made substantial progress in poverty reduction. Driven by a shift from rural agricultural to urban industrial and service economies, growth and its benefits have not been uniform across all countries. Obstacles include human resource challenges, as the region's educational systems cannot readily satisfy the growing demand for highly skilled professionals. A transition to greater democracy has also been characteristic of the past twenty years in the region and includes the shift from a military junta to a civilian government in Myanmar. But most remote and inaccessible mountain areas have not felt much democratization: they continue to receive very limited government support for development and social services and have developed structures of authority and governance that are not related to formal state institutions. This situation increases the susceptibility of the region's mountains to internal or international armed conflict. Simultaneously with the democratic changes mentioned, Southeast Asia and the Pacific has also experienced a trend towards decentralization and the devolution of power and authority to local political units since the 1990s. Although decentralization and devolution processes are still at a very early stage and face human, financial and political constraints, they have already contributed to the well-being of some indigenous mountain communities, mainly through the provision of land and use rights in protected forests.

Mountain natural resources support a wide range of industries and offer vast opportunities for green enterprise development in Southeast Asia and the Pacific. However, these resources need to be better harnessed by strengthening institutions and by engaging all stakeholders in sustainable development. States must heighten public awareness of mountains' benefits, mainstream mountain protection into their policies and development strategies and strive for better transboundary co-operation to conserve and better manage shared mountain resources. Payment for ecosystem services schemes, including the Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism, as well as green tourism offer alternatives for tackling global challenges, helping further development in the mountain areas of Southeast Asia and the Pacific, preserving traditional cultures and bringing in financial resources to develop health, transportation, education and communication infrastructure in remote mountain villages.

Policy action for the mountains of Southeast Asia and the Pacific

In Southeast Asia and the Pacific, issues about equity, social justice and ownership have raised doubts about the sustainability of mountain initiatives and hampered development efforts. A mountain-focused public policy and participatory actions can help build community resilience and support the region's mountain systems in the long term. The following list outlines recommended public policy actions.

Develop good governance and equitable mechanisms. Economic accounting for the full value of mountain ecosystem goods and services must be established. Compensating mountain regions for their unique characteristics and great biodiversity can help reduce poverty and at the same time incentivize the conservation of forests, other natural ecosystems and their biodiversity based on sustainable development plans and programmes.

Promote inclusive approaches that give mountain peoples a voice. Assisting mountain communities in negotiations and collaborative dialogues is necessary to help them resolve conflicts and enable them to achieve equitable benefit sharing and co-management of resources in collaboration with the government, civil society, donors and the private sector.

Strengthen collaborative research. Combining traditional practices and scientific knowledge can help develop actionable plans to be implemented through meaningful participation of stakeholders both in the mountains and downstream.

Develop livelihoods based on mountain resources. In light of the growing possibility of increased outside investment in the region's mountains, including by the private sector, equitable sharing of profits with mountain dwellers will not only help finance efforts to conserve ecosystems but can also provide additional income to local communities.

Consolidate international and national funding mechanisms. Synergies, efficiency and coherence among international and national financing instruments and mechanisms need to be increased in order to promote immediate actions within sustainable development programmes in Southeast Asia and the Pacific.

Extracted from: Razal, R. A., Karki, M., Sánchez, B. Q., Aksha, S. & Mahat, T. J. 2012. *Sustainable Mountain Development in South East Asia and Pacific: From Rio 1992 to Rio 2012 and Beyond*. Manila, The Philippines: International Centre for Integrated Mountain Development (ICIMOD), Non-Timber Forest Product-Exchange Programme for South and Southeast Asia. 67 pp.



Issues and opportunities in central, eastern and southeastern Europe

Bieszczady National Park, Poland. (Juliusz Stola)

Why mountains in central, eastern and southeastern Europe matter

The mountains of central, eastern and southeastern Europe have played a key social, economic and environmental role in the development of the region's nations and peoples. Being both natural barriers and safe havens not only for people, but also for flora and fauna, these mountains have been instrumental in shaping today's Europe.

"The mountain sun brings people together faster than a city's amusements." (Jan Alfred Szczepański, 1902–1991)

The Balkans, Dinaric Arc, Carpathians and Caucasus are large transboundary European mountain ranges located in dynamic geopolitical regions (Figure 4.15). These mountain regions have global significance, as they provide ecosystem goods and services that are vital to sustainable development, in particular to the lowlands and the communities living there. But mountains are highly vulnerable to global change. Given the close linkages and dependencies between highlands and lowlands, these changes may have serious impacts far beyond the mountains themselves.

How current trends affect sustainable mountain development in central, eastern and southeastern Europe

Europe's mountainous macroregions are developing dynamically in some parts while at the same time experiencing political and economic marginalization in other parts. In some cases they are involved in territorial disputes and conflicts resulting from the past. They are a living environment inhabited by millions of people, but subject to a variety of heavy pressures ranging from migration and unemployment to land-use change, habitat conversion and fragmentation, deforestation, climate change impacts, industrialization, mining (Figure 4.16), pollution, exploitation of natural resources, environmental degradation, energy needs and water scarcity.

An important asset of these mountain regions is their uniquely diverse natural and cultural heritage, which provides an ecological and cultural link within Europe. They are home to a multitude of ethnic groups, cultures and religions and represent pools of agro- and natural biodiversity that are of worldwide importance and host numerous relic and endemic flora and fauna. Their significance as crossroads and transit regions cannot be overlooked in today's global economy. In countries with economies in transition, mountain forest resources play a significant role in generating national income. The diverse functions, goods and services provided by these ecosystems – recreation, tourism, water, wood, non-timber forest products and others – generate sustainable benefits. Local populations often depend strongly on agriculture, but have unique opportunities for producing organic and high-quality products. Moreover, these picturesque regions offer potential for developing environmentally friendly sustainable tourism as a source of livelihood for local people. Architecture, rural arts and crafts, as well as indigenous knowledge have been particularly well preserved. There is also potential for sustainable supply of renewable energy.

Both the challenges and the opportunities for substantial improvement in all aspects of transboundary and national sustainable mountain development are enormous. Successes can lead to increased regional collaboration and stability, as the European experience shows. The challenges of sustainable mountain development require intergovernmental cooperation. As an example, in the Carpathians, international cooperation within the Framework Convention on the Protection and Sustainable Development of the Carpathians provides a solid basis for measures to balance environmental protection and sustainable regional development, and to improve the living conditions for the local population.

Policy action for the mountains of central, eastern and southeastern Europe

Continued efforts will be required to sustainably manage and protect mountain ecosystems as well as to reduce poverty, improve food security and nutrition, combat social exclusion and slow environmental degradation in these areas. States are invited to strengthen cooperative action based on effective involvement of all relevant stakeholders and sharing of experiences. This can be done by establishing

Figure 4.15: Mountains in central, eastern and southeastern Europe



new or strengthening existing regional agreements, arrangements and centres of excellence for sustainable mountain development. Recommended policy actions on a number of key issues are outlined below.

Create mechanisms to compensate mountain communities for their resources and services. Mechanisms should be developed at the regional, national and local levels in order to justly support mountain communities in providing essential resources and services for human well-being.

Support green and low-carbon economic activities in mountain regions. Actions should focus on capacity building, on promoting the development of suitable technologies and on devising innovative financing mechanisms to support sustainable development and ecosystem conservation in mountain regions.

Strengthen regional research and development institutions. Regional centres of excellence in research and development play a pivotal role when it comes to achieving solutions that take into account the specificities of each mountain region. Creating or strengthening regional centres will also enhance interregional cooperation and support partnerships between mountain macroregions in Europe as well as elsewhere.

Promote integrated, ecosystem-based management approaches that take into account highland–lowland linkages, transboundary cooperation and resource efficiency. Innovative institutional arrangements for regional and transboundary cooperation, based on a multisectoral approach, are urgently required to facilitate effective governance models and decision support systems, as well as the mainstreaming of mountains into overall national development and conservation processes. The Carpathian Convention – the only mountain convention



Figure 4.16: Mining in the western Balkans



Mountain village in Digoria, North Ossetia-Alania, Russia. (Thomas Kohler)

adopted since 1992 – is a regional governance mechanism and a best-practice example of an institutional framework for promoting sustainable development and green economy in mountain regions.

Harness new opportunities for public–private partnerships and investments in mountain ecosystem goods and services. Potential exists particularly in the fields of conservation, renewable energy, sustainable forest management, sustainable tourism, responsible industrial development and climate-smart agriculture, including promotion of natural products. Actions to support sustainable mountain development are key to achieving the Millennium Development Goals and the new Sustainable Development Goals.

Extracted from: Hugill, M., ed. 2012. *Sustainable Mountain Development in Central, Eastern and South Eastern Europe: From Rio 1992 to Rio 2012 and Beyond*. Vienna, Austria: Mountain Partnership. 44 pp.



Issues and opportunities in the European Alps

Val Maroz, Bergell, Switzerland. (W. Schmid)

Why the European Alps matter

The European Alps cover an area of 190,568 km² and are home to 14 million people across seven countries (Figure 4.17). Due to their central location in western Europe, the Alps have many important roles on the continent. The Alpine economy is based on a symbiosis of various sectors, including tourism, services, industry, power generation and agriculture. The region is highly heterogeneous and polarized and shows great disparities, especially in terms of population, unemployment, economic density and gross domestic product.

"I look for happiness and the mountain responds to my search." (Chantal Mauduit, 1964–1998)

How current trends affect sustainable mountain development in the European Alps

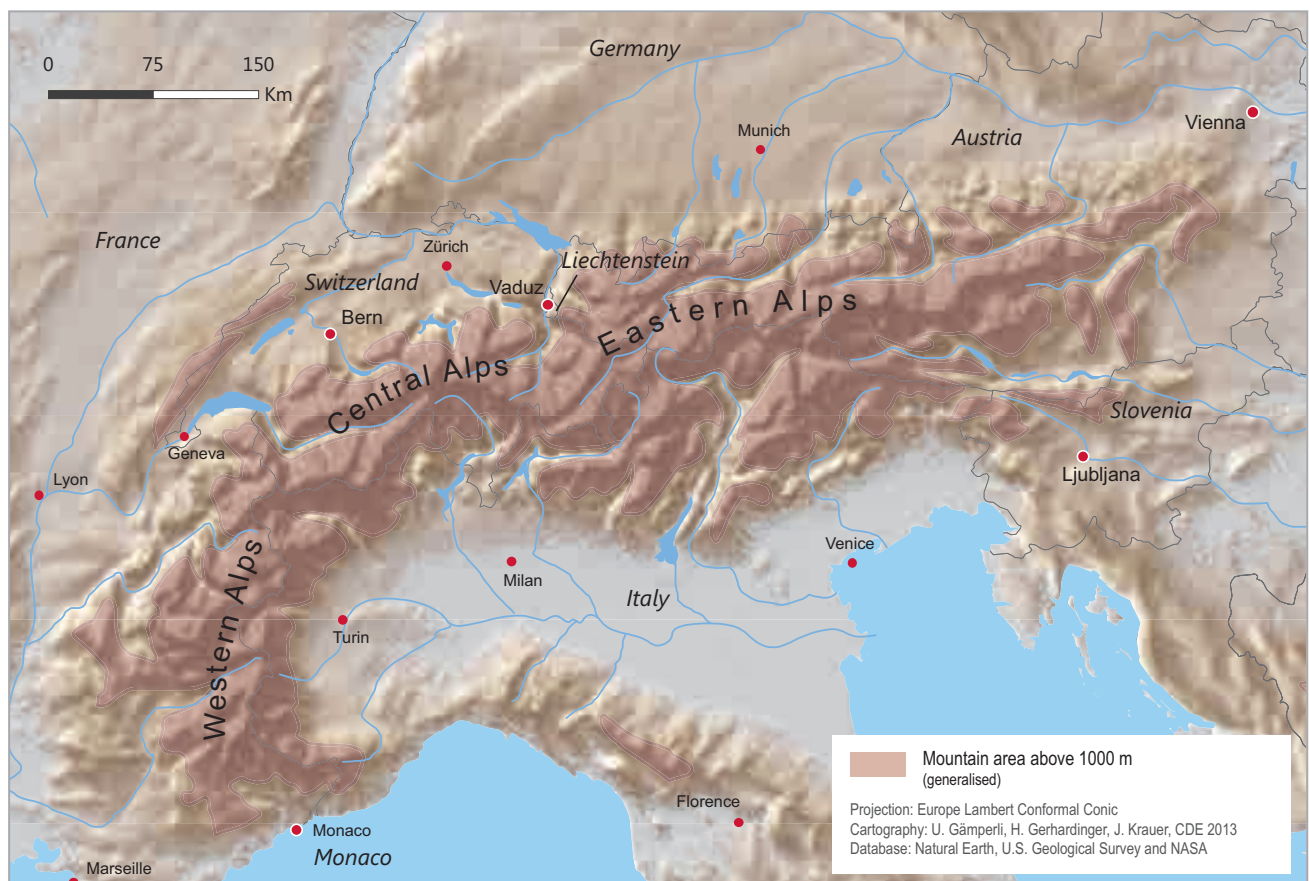
The European Alps have long been a habitat for human settlement. They are rich in cultural heritage, traditions, local know-how and economic activities and offer vital ecosystem goods and services to local inhabitants, downstream populations and, indirectly, to the whole of Europe. Spectacular landscapes and countless recreational opportunities bring over 60 million tourists and 60 million day visitors to the Alps each year, providing 10 to 12 percent of the region's total employment and sustaining the economy of 10 percent of its municipalities (Figure 4.18). The Alps play a crucial role in the continent's water balance, hydropower generation, farmland irrigation and freshwater provision for domestic and industrial use (Figure 4.19), as they include almost two-thirds of western Europe's glaciated area, many large lakes and the headwaters of most of Europe's major rivers. The Alps also modulate the European continental and regional climates and play a fundamental role in carbon storage and air quality regulation.

More than half of the terrain in the Alps is covered by forests and woodlands, and this proportion is increasing. The region is a biodiversity hotspot, with mountain forests, natural grasslands and heathlands hosting many endemic plant and

animal species and nearly 40 percent of the total flora of Europe. Protected areas designated under national legislation cover 25 percent of the area of the Alps and contribute to conserving the region's high biodiversity. However, continued fragmentation and loss of habitat, pollution, changing crop and livestock farming practices and intensities and climate change pose serious threats to ecosystem goods and services. Over the past century, average temperatures in the region rose by more than 1.5 °C, more than twice the global average. Recent trends such as reduced snowfall at lower altitudes and glacier retreat are expected to become more pronounced. Projected climate changes – including warmer winters with more precipitation, much warmer and drier summers, altered timing and amount of runoff and more frequent floods and droughts – will have serious impacts on agriculture, pastures, soil stability and water availability, with repercussions far beyond the Alps.

A further challenge to sustainable development in the European Alps is the process of polarization and internal differentiation observed during the past four decades. Agricultural and forested peripheral areas are increasingly experiencing economic and demographic decline, while prosperous urban and highly touristic regions face the need to optimize land use to avoid overexploitation. This trend of simultaneous growth and decline also occurs at the interface between the Alps and adjacent lowland areas. Greater job opportunities in peri-Alpine metropolises such as Milan, Vienna and Munich are increasingly transforming the nearby parts of the Alps into dormitories and leading to their suburbanization. Furthermore, with services increasingly concentrated in peri-Alpine metropolises, inner Alpine cities are losing some of their functions as regional centres, and their resources are captured for the benefit of the peri-Alpine metropolises. Urban sprawl and infrastructure development have consumed large areas of land, significantly modifying landscapes and fragmenting habitats. The increasing competition for land in the

Figure 4.17: The European Alps



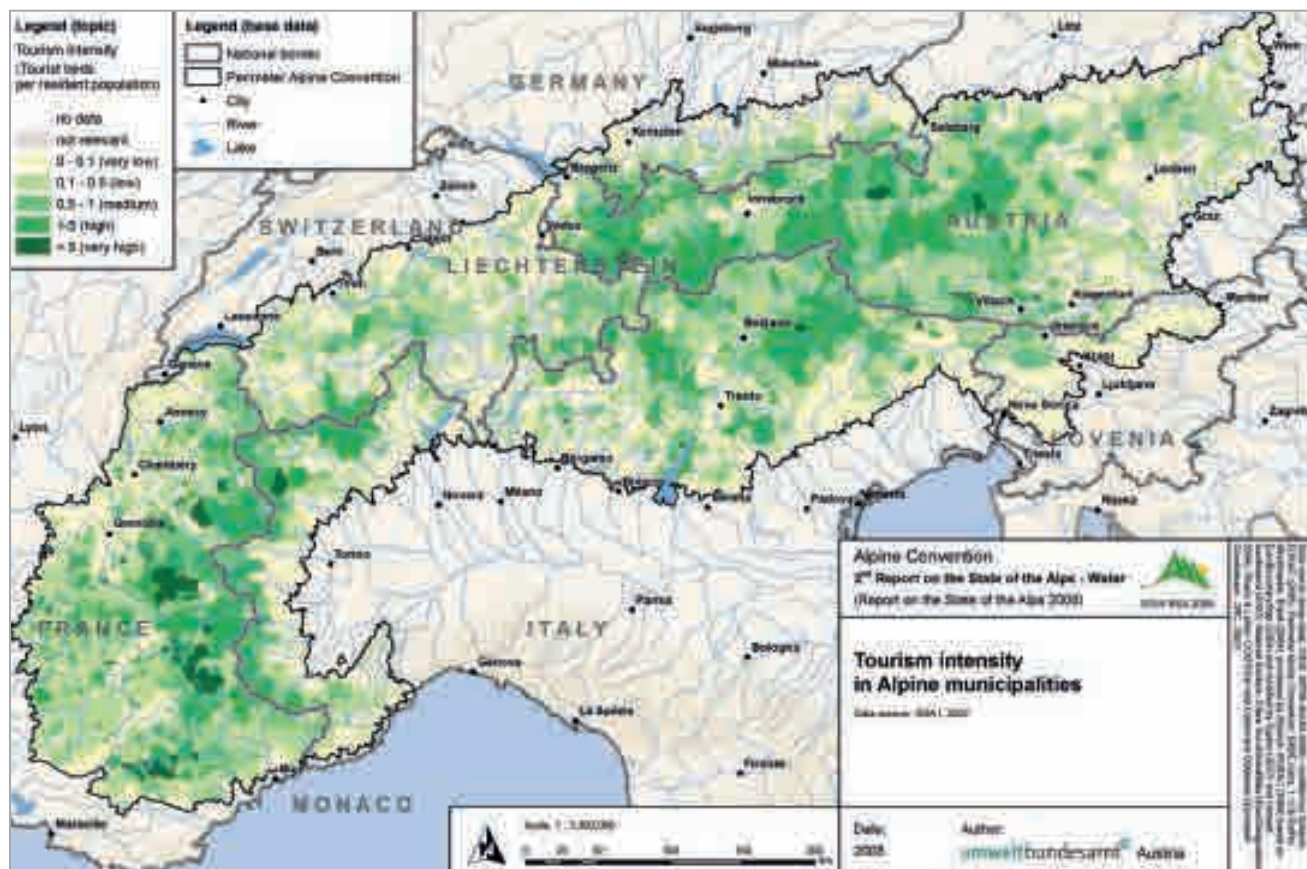
developed areas of the Alps is causing land prices to rise, making it more difficult for local people to stay and to maintain their agricultural activities. To cope with the various challenges and threats, Alpine communities and governments have been promoting local expertise, networks and regional centres of excellence active in fostering development and creativity.

A long history of institutional frameworks, governance mechanisms and policy instruments relating to sustainable mountain development in the Alps preceded the publication of *Agenda 21* in 1992. There is also a well-established tradition of interregional and transboundary cooperation and the use of legislation to address challenges specific to the Alps. Following Rio 1992, many initiatives for sustainable mountain development were devised and implemented across the Alps.

The European Alps were the first mountain range to benefit from a dedicated international legally binding instrument: the Alpine Convention. Concluded in 1991, this treaty for the sustainable development of the Alps has spurred the development of a rich governance toolbox based on transboundary cooperation, partnerships and networks. This enables stronger vertical and horizontal involvement of stakeholders ranging from political decision-makers to non-governmental organizations and civil society actors from different fields and geographic regions, which in turn makes it possible to better tackle emerging issues at their specific functional level.

Despite this progress towards sustainability, the European Alps remain under strong pressure. Changes in population patterns due to ageing, migration, territorial polarization, the decline of peripheral areas and the weakening of social cohesion threaten the region's socio-economic prosperity and the well-being of its populations. From a wider point of view, various developments, such as climate

Figure 4.18: Tourism intensity (number of tourist beds per resident population) in Alpine municipalities



change, international economic competition, Alpine transit traffic, decreasing biodiversity and land consumption, threaten the ability of the Alps to provide goods and services to Europe as a whole.

The heterogeneity of situations across the Alps and the complexity of the challenges faced require solutions that are adapted to the various geographic areas. Sustainable development is the shared goal, but the means to achieve it must be diverse.

Policy action for the European Alps

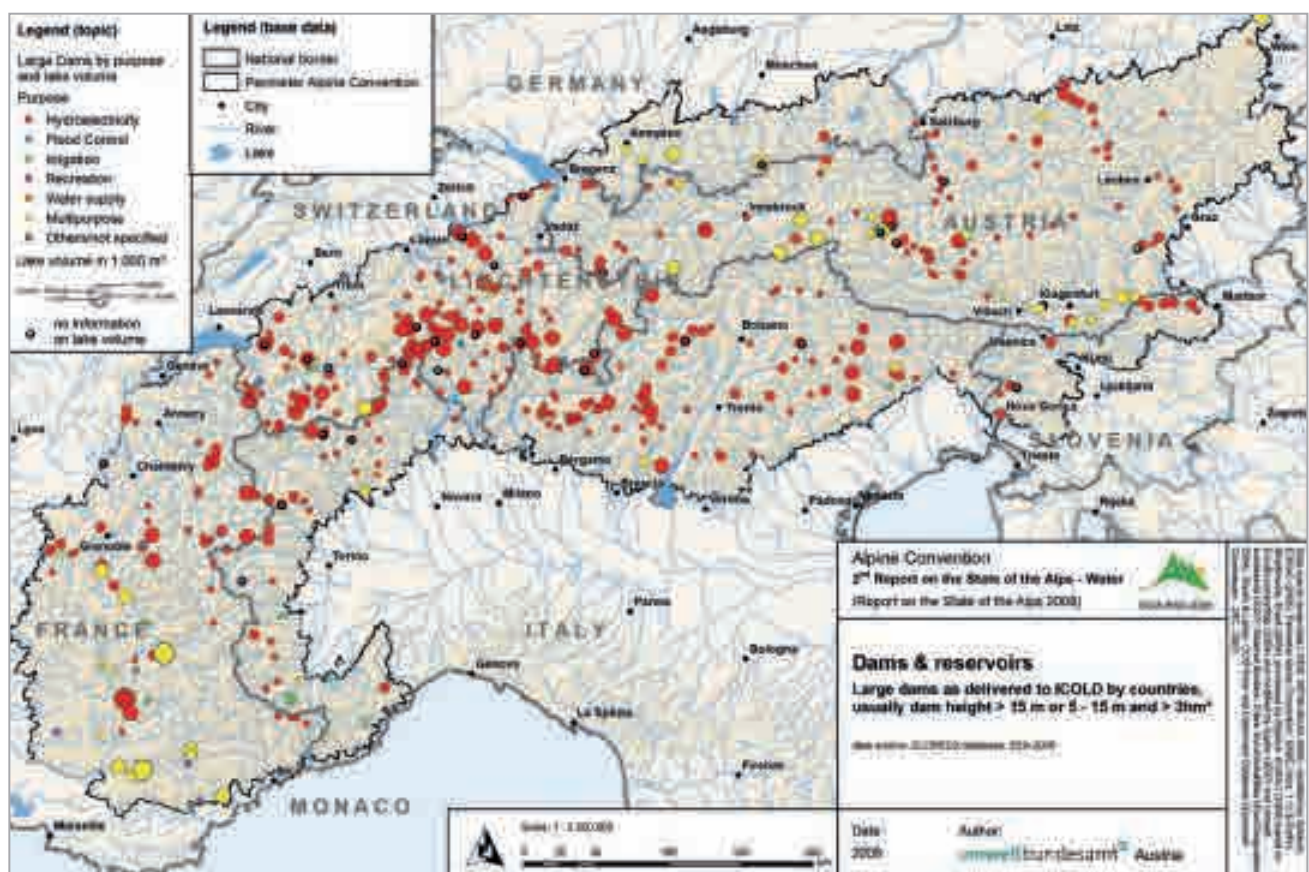
Political agendas must respond to the complexity, role and interdependencies of activities in the European Alps. The key need is for place-based policies that integrate different sectors from a functional perspective in a multi-level and multi-stakeholder implementation framework. Comprehensive solutions must cross institutional and national borders.

Adapt to climate change and mitigate its impacts. Adaptation to climate change should include a new culture of risk with regard to natural hazards, as well as reinventing Alpine tourism and devising new strategies for environmental protection. The European Alps can contribute to climate change mitigation by unlocking their potential to produce renewable energies and increasing energy efficiency through traditional knowledge and the use of natural resources in construction.

Manage natural and human resources wisely. Sustainable use of Alpine assets should be fostered through policy actions that focus on:

- implementing sustainable water management with consideration of the various needs for energy, agricultural, industrial, tourist and domestic uses;

Figure 4.19: Dams and reservoirs in the European Alps





Grindelwald with Wetterhorn, Switzerland. (Urs Wiesmann)

- controlling urbanization by limiting multilocal living and the construction of second homes, and by supporting the shift of transit traffic from road to rail;
- promoting mechanisms that ensure compensation of the Alpine region by users of its resources and ecosystem services;
- establishing connectivity networks to enhance biodiversity; and
- supplying services of general interest and stimulating job opportunities.

Direct governance and innovation towards a green economy. The European Alps have considerable potential for technical innovation and for generating added value. Innovation and investment should be directed towards a green economy, notably in the fields of environmentally friendly tourism, protected areas, agricultural policies, income diversification and renewable energies. Governance that draws on the knowledge and know-how of people living in the Alps and reflects the different levels of action and decision-making needs to include local bottom-up initiatives as well as national, international and transnational institutions.

Strengthen cooperation and foster functional relationships. The Alpine states share a common territory and assets: natural resources, knowledge, social capital, networks and many others. Accordingly, it is important that they engage in efficient regional cooperation at all scales. The focus should increasingly be on fostering functional relationships between all relevant actors (agreements, territorial entities, non-governmental organizations, research institutes, regional centres of excellence).

Extracted from: Price, M. F., Borowski, D., Macleod, C., Rudaz, G. & Debarbieux, B. 2012. *Sustainable Mountain Development in the Alps: From Rio 1992 to Rio 2012 and Beyond*. Bern, Switzerland: Swiss Federal Office for Spatial Development (ARE). 76 pp.



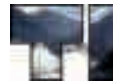
A scenic mountain landscape. In the foreground, a dirt path leads up a grassy slope. To the left, a small stream flows. In the background, majestic mountains with snow-capped peaks rise against a clear blue sky.


Further reading

Further reading

- Berrahmouni, N., Romeo, R., McGuire, D., Zelaya, S., Maselli, D. & Kohler, T., eds. 2011. *Highlands and Drylands: Mountains, a Source of Resilience in Arid Regions*. Rome, Italy: FAO (Food and Agriculture Organization of the United Nations), UNCCD (United Nations Convention to Combat Desertification), Mountain Partnership, SDC (Swiss Agency for Development and Cooperation), CDE (Centre for Development and Environment). 113 pp. (Available at: <http://www.fao.org/docrep/014/i2248e/i2248e00.pdf>)
- Chassot, O., Valverde, A., Jiménez, V., Müller, E. & Moreno, T. 2012. *Sustainable Mountain Development in Meso America: From Rio 1992 to Rio 2012 and Beyond*. San José, Costa Rica: Latin American School for Protected Areas (ELAP), University for International Cooperation (UCI), Tropical Science Center (TSC). 96 pp. (Available at: <http://pavilion.mtnforum.org/en/content/sustainable-mountain-development-meso-america-rio-1992-rio-2012-and-beyond>)
- Devenish, C. & Gianella, C., eds. 2012. *Sustainable Mountain Development in the Andes: From Rio 1992 to 2012 and Beyond*. Lima, Peru: Consorcio para el Desarrollo Sostenible de la Ecorregión Andina (CONDESAN). 66 pp. (Available at: <http://pavilion.mtnforum.org/en/content/sustainable-mountain-development-andes-rio-1992-rio-2012-and-beyond>)
- FAO [Food and Agriculture Organization of the United Nations]. 2011. *Why Invest in Sustainable Mountain Development?* Rome, Italy: FAO. 73 pp. (Available at: <http://www.fao.org/docrep/015/i2370e/i2370e.pdf>)
- Hughes, G., ed. 2012. *Sustainable Mountain Development in Central Asia: From Rio 1992 to Rio 2012 and Beyond*. Bishkek, Kyrgyzstan and Geneva, Switzerland: University of Central Asia (UCA), Zoï Environment Network. 148 pp. (Available at: <http://pavilion.mtnforum.org/sites/default/files/Central-Asia-Mountains.pdf>)
- Hugill, M., ed. 2012. *Sustainable Mountain Development in Central, Eastern and South Eastern Europe: From Rio 1992 to Rio 2012 and Beyond*. Vienna, Austria: Mountain Partnership. 44 pp. (Available at: <http://mountainslucerne2011.mtnforum.org/sites/default/files/EAST-ERN%20EUROPE-VERY%20FINAL.pdf>)
- ICIMOD [International Centre for Integrated Mountain Development], ed. 2011. *Green Economy for Sustainable Mountain Development: A Concept Paper for Rio+20 and Beyond*. Kathmandu, Nepal: ICIMOD, 30 pp. (Available at: <http://pavilion.mtnforum.org/sites/default/files/Green%20Economy%20%20Concept%20Paper.pdf>)
- Karki, M., Sharma, S., Mahat, T. J., Tuladhar, A. & Aksha, S. 2012. *Sustainable Mountain Development in the Hindu Kush–Himalaya: From Rio 1992 to Rio 2012 and Beyond*. Kathmandu, Nepal: International Centre for Integrated Mountain Development (ICIMOD). 73 pp. (Available at: http://pavilion.mtnforum.org/sites/default/files/HKH_FINAL_Regional_Report_HKH_29May.pdf)
- Kohler, T. & Maselli, D., eds. 2009. *Mountains and Climate Change: From Understanding to Action*. Bern, Switzerland: Geographica Bernensia, Swiss Agency for Development and Cooperation (SDC). 76 pp. (Available at: http://www.cde.unibe.ch/userfiles/Fullversion_low_Mountains_and%20_Climate_Change.pdf)
- Messerli, B. & Ives, J., eds. 1997. *Mountains of the World: A Global Priority*. New York, London: Parthenon. 495 pp.

- Price, M. F., Borowski, D., Macleod, C., Rudaz, G. & Debarbieux, B. 2012. *Sustainable Mountain Development in the Alps: From Rio 1992 to Rio 2012 and Beyond*. Bern, Switzerland: Swiss Federal Office for Spatial Development (ARE). 76 pp. (Available at: <http://pavilion.mtnforum.org/sites/default/files/ALPS%20FINAL%2020120228%20RIO%20Alps.pdf>)
- Price, M. F., Gratzner, G., Lalisa Alemayehu Duguma, Kohler, T., Maselli, D. & Romeo, R., eds. 2011. *Mountain Forests in a Changing World: Realizing Values, Addressing Challenges*. Rome, Italy: Food and Agriculture Organization of the United Nations (FAO)/Mountain Partnership Secretariat, Swiss Agency for Development and Cooperation (SDC). 83 pp. (Available at: http://www.mountainpartnership.org/fileadmin/user_upload/mountain_partnership/docs/FAO_Mountain-Forests-in-a-Changing-World.pdf)
- Razal, R. A., Karki, M., Sánchez, B. Q., Aksha, S. & Mahat, T. J. 2012. *Sustainable Mountain Development in South East Asia and Pacific: From Rio 1992 to Rio 2012 and Beyond*. Manila, The Philippines: International Centre for Integrated Mountain Development (ICIMOD), Non-Timber Forest Product-Exchange Programme for South and Southeast Asia. 67 pp. (Available at: <http://pavilion.mtnforum.org/en/content/sustainable-mountain-development-south-east-asia-and-pacific-rio-1992-rio-2012-and-beyond>)
- Spehn, E. M., Rudmann-Mauer, K., Körner, C. & Maselli, D., eds. 2010. *Mountain Biodiversity and Global Change*. Basel, Switzerland: GMB-DIVERSITAS. 59 pp. (Available at: http://gmba.unibas.ch/publications/pdf/Mountain_Biodiversity_Brochure2010.pdf)
- Victor, R. 2012. *Sustainable Mountain Development in the Middle East and North Africa: From Rio 1992 to Rio 2012 and Beyond*. Al Khoudh, Sultanate of Oman: Sultan Qaboos University. 108 pp. (Available at: <http://pavilion.mtnforum.org/en/content/sustainable-mountain-development-middle-east-and-north-africa-rio-1992-rio-2012-and-beyond>)
- Wallace, R. J., DeVore, K., Lifton-Zoline, P. & Lifton-Zoline, J. 2012. *Sustainable Mountain Development in North America: From Rio 1992 to Rio 2012 and Beyond*. Telluride, CO, USA: Aspen International Mountain Foundation, The Telluride Institute. 97 pp. (Available at: <http://pavilion.mtnforum.org/en/content/sustainable-mountain-development-north-america-rio-1992-rio-2012-and-beyond>)
- United Nations Conference on Environment and Development (UNCED). 1992. *Agenda 21: Programme of Action for Sustainable Development*. UN Doc. A/CONF.151/26/Rev.1 (Vol. 1), Annex II (1992). Rio de Janeiro, Brazil: United Nations. 351 pp. (Available at: <http://sustainabledevelopment.un.org/content/documents/Agenda21.pdf>)
- United Nations Environment Programme (UNEP). 2012. *Why Mountains Matter for Africa: Policy Brief on Sustainable Mountain Development, Rio 2012 and Beyond*. Bern, Switzerland: UNEP, Research Network on Global Change in African Mountains (AfroMont). 2 pp. (Available at: http://pavilion.mtnforum.org/sites/default/files/Print_Africa_Policy_Brief_RIO%202012.pdf)
- United Nations Conference on Sustainable Development. *The Future We Want*. UN Doc. A/RES/66/288 (11 September 2012). 53 pp. (Available at: <http://sustainabledevelopment.un.org/futurewewant.html>)





The world's mountains are home to almost one-eighth of the global population and offer human-kind indispensable ecosystem goods and services. They supply half of the world's population with freshwater. They are centres of immense cultural and biological diversity, sources of valuable raw materials and important tourist destinations. However diverse, nearly all mountain regions suffer from poverty, widespread land degradation and adverse impacts of climate change. This report gives an overview of the many environmental and social issues of key global importance that are at stake in the world's mountains – from migration and urbanization to food security and conflict, from water supply and energy production to waste management and natural hazards. The report includes a road map with policy principles and recommended actions to secure the role of mountain environments and their people in preserving globally vital resources and mastering the challenge of global sustainable development. This report was prepared based on regional contributions for the Rio+20 conference.

ISBN: 978-3-905835-18-2



u^b

UNIVERSITÄT
BERN

CDE
CENTRE FOR DEVELOPMENT
AND ENVIRONMENT



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development
and Cooperation SDC